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Since this machine has such extraordinary performance at such a low price, we believe it represents the best value in the market today.

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Based on the Intel 80386 microprocessor, Phoenix BIOS, One 1.2MB Floppy Diskette Drive (Optional 360K 5.25" Floppy Drive or 720K 3.5" Floppy Drive or 1.44MB 3.5" Floppy Drive), socketed for 80387 math co-processor, 8 Expansion Slots, Two Serial Ports, One Parallel Port, Real Time Clock, Floppy Controller and Hard Drive Controller, 101 Enhanced Keyboard. Available with 32-bit memory in the following RAM configuarations: 2 Mb, 4MB, 8 MB, 16 MB. Features a small footprint, yet it can take as many cards and drives (including hard drives) as full-sized models.

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COMPACT 386-20

a 20MHz version of the above configuration.

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COMPACT 286-16
(16 MHz, 8-slot AT Compatible)

Based on the Intel 80286 microprocessor, Phoenix BIOS, One 1.2MB Floppy Diskette Drive (Optional 360K 5.25" Floppy Drive or 720K 3.5" Floppy Drive or 1.44MB 3.5" Floppy Drive), socketed for 80287 math co-processor, 640K RAM (Optionally expandable to 1 MB onboard or higher using 16-Bit memory expansion cards), 8 Expansion Slots, Two Serial Ports, One Parallel Port, Real Time Clock, Floppy Controller and Hard Drive Controller, 101 Enhanced Keyboard.

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Electronics & Technology Today

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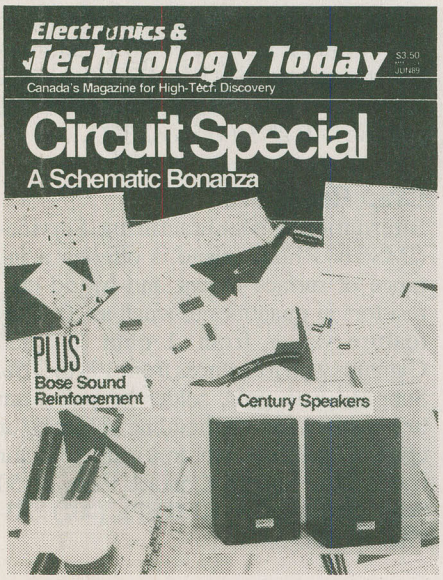

Our Cover

Our circuit collection appears on page 8 and our review of the Century powered speakers on page 7; photos by Bill Markwick.

FEATURES

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PRODUCT REVIEW

PROJECTS

INFORMATION

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We cannot answer telephone queries. Written queries must be accompanied by a stamped, self-addressed envelope, relate to recent articles and must not involve the staff in any research.

PCB SUPPLIERS
We do not supply printed circuits or kits, and we do not keep track of availability. However, PCBs for projects are available from the following mail order sources:
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K.S.K. Associates, PO Box 266, Milton, Ontario L9T 4N9.
Spectrum Electronics, 14 Knightswood Crescent, Brantford, Ontario N3R 7E6.

New Dell 386SX

Dell Computer Corporation has introduced the new System 316 16MHz computer based on the Intel 386SX processor. The SX allows the customer to run powerful software such as the 386 versions of OS/2 or Unix while keeping the price below that of a full 32-bit system. With a 29-millisecond 40M hard drive, one megabyte and a monochrome display, the 386SX price is $4,499. For further information, contact them at The Dell Building, 2 East Beaver Creek Road, Richmond Hill, Ontario L4B 2N3, (416) 881-3513.

Chip Resistors

International Manufacturing Services (IMS) of Rhode Island is offering a full range of surface mount and hybrid chip resistors in quantities as small as 10. They feature values from .1 ohm to 1,000 Gigohms with tolerances from 1% to 20%. Supplied with gold, solder or palladium terminations for wire bonding, soldering or epoxy attach, the resistors can be color coded if necessary. Contact them at 50 Schoolhouse Lane, RI 02871, (401) 683-9700, Fax 683-5571.

dbx Sold to AKG

The dbx Professional Products Division has received a letter of intent to purchase from AKG Acoustics, Stamford, CT, and it has been accepted. AKG is a well-known name in professional audio equipment. The dbx Consumer Products division remains as before, under the ownership of Carillon Technology, Inc.

33MHz 386

Compaq Canada Inc. has announced a new 33MHz 386 computer, the Deskpro 386/33. With 64K of high-speed cache, a unique architecture and high-speed memory, it is claimed to be the world's most powerful desktop computer. The display is VGA color, downward compatible with EGA and CGA. The internal memory can be expanded to 16M without using up an expansion slot. Internal data storage can go as high as 1.3 gigabytes. With 2M of RAM, one 1.2M floppy drive and an 84M hard drive, the 386/33 has a suggested retail price of $15,749. Other models include 320M and 650M hard drives, tape drives, etc. Compaq Canada, Inc., 111 Granton Drive, Suite 101, Richmond Hill, Ontario L4B 1L5, (416) 733-7876, Fax 764-7010.

Continued on page 37

Century Powered Speakers

Self-contained bookshelf speakers are ideal for your personal stereo.

BILL MARKWICK

Adding speakers to your personal cassette player poses the problem of buying an amplifier of some sort; if you want to run extension speakers from your main stereo into another room, you can't change the volume without going back to your amp or tuner.

The Century CA5200 Speaker Booster solves both problems. There are two small bookshelf speakers just over 4" by 4" by 7"; each has a 4" bass driver, 2" midrange and a 1" tweeter. Inside one of the speakers is a 20 watt per channel stereo amplifier with separate left and right volume controls.

The speakers are hooked together with speaker wire, connected to a power outlet, and the twin phono cords coming from the powered speaker are plugged into any line-level source, such as a tape deck, Walkman, TV, CD, stereo tuner, etc. The diminutive cabinets can be placed anywhere without taking up much room, or you can use the supplied brackets for wall-mounting, assuming that you can deal with the power cord, input cord and output wire (no problem in a workshop, for instance, though a bit obtrusive in a living room unless you can conceal them).

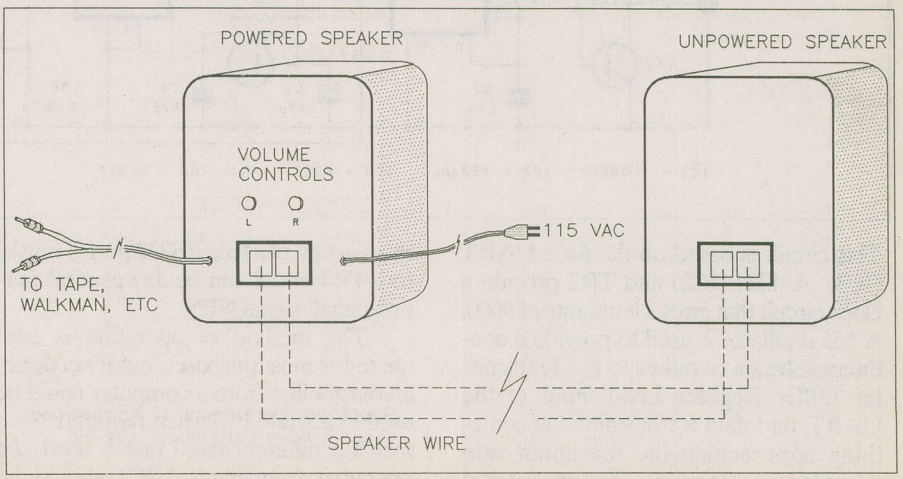
The 20W amplifier is rated at 0.5% total harmonic distortion, not an extremely low value, but more than adequate for the application; the -3dB points are 40Hz and 15kHz. The rated impedance for the speakers is four ohms and the maximum line input to the power amp is two volts.

Listening tests in a living room proved the speakers to be very clean, and capable of room-filling, if not ear-shattering, sound levels. The bass response was very good, always surprising to those of us conditioned to think that big bass means a big box. My only complaint was a midrange sound slightly louder than it should have been, making vocals sound a bit nasal. On the other hand, other listeners weren't bothered by this, so it's really a matter of preference.

The Century CA5200 system is an excellent way to improve the sound of personal stereos or TVs, and makes for very convenient extension speakers, complete with volume controls. It would even do a fine job as your main stereo, assuming that you have a preamp or other source with line level outputs.

The speakers are manufactured in Taiwan to the specifications of the importer, Century Electronics. The suggested retail price is $99.95 for the pair, and the units are CSA/UL approved.

The exclusive distributor of the Century is Cableserv Electronics, 18 Dufflaw Road, Toronto, Ontario M6A 2W1, (416) 789-4581, Fax 789-3838, or toll-free 1-800-668-2033. ■



One of the Century speakers contains a 20W stereo amplifier which drives both sides.

FEATURE

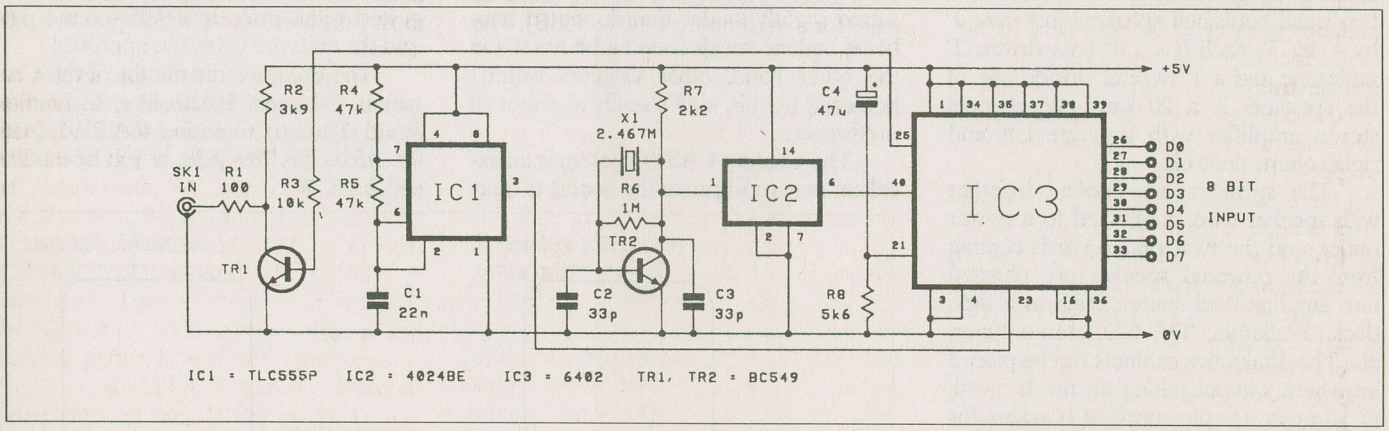
Circuit Special

Our collection of various circuits, audio, digital, games and more.

Our collection of circuits comes from a wide collection of sources, mostly readers of *Electronics & Technology Today*. While we try to reproduce the circuits exactly, we present them untested, having taken the word of the submitters that they work. Althought the circuitry is not the highest of tech, lots of experience with reading schematics and constructing projects is necessary.

We've tried to present circuits that use commonly available parts, and if you can't find the exact part number, you should be able to substitute easily. For instance, unless the author insists on a particular op amp, you can use whatever you have. The transistors in the circuits are usually garden-variety small- signal; almost anything should work as long as it's the right gender (no swapping NPN for PNP — the circuits aren't *that* versatile). If the transistors are power types, we've tried to use common part numbers. Capacitors are not critical, either, unless the author wants a particular type for stability. Warm up your soldering irons.

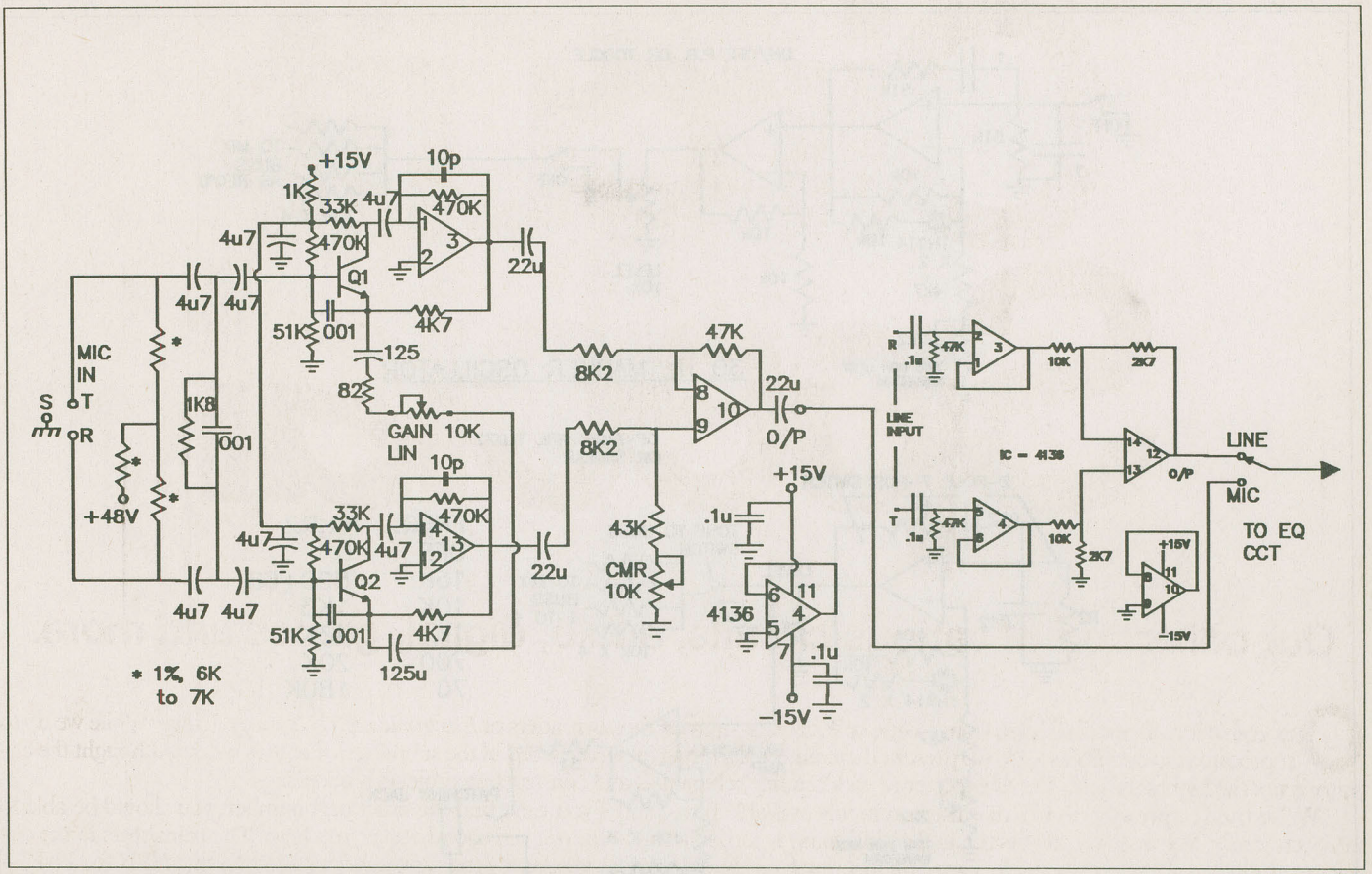
PARALLEL TO SERIAL CONVERTER



This circuit is based on the 6402 UART (IC3). A 4024 (IC2) and TR2 provide a clock circuit that gives a baud rate of 9600. A 555 oscillator is used to provide a continuous stream of pulses to the Transmitter Buffer Register Load input of the UART, and data is transmitted at something approaching the maximum rate possible for 9600 baud. The serial output at SK1 is similar to TTL level rather than the +/-12V of a true RS232 port. Transistors TR1 and 2 can be any general purpose small-signal NPN.

The method of operation is adequate for most purposes, but if necessary an output line from a computer could be used to activate IC3 when required. Note that if a different baud rate is used, the operating frequency of IC1 should be speeded up or slowed down in proportion; the operating frequency of IC1 is inversely proportional to the value of C1. An excessive trigger rate is unlikely to cause any problems with corrupted data, though, since IC3 will almost certainly ignore any excess trigger pulses.

If a low-power 555 is used for IC1, current consumption is only about 10mA. Add another 4mA if a standard 555 is used.



TRANSFORMERLESS LINE/MIC AMP

This circuit was originally designed for a mixing console because of the high cost of audio input transformers. The input impedance is about 1200 ohms, ideal for any low-impedance microphone. Balancing can be trimmed to better than 70dB, as good as a professional-quality transformer. The microphone gain is variable with a single pot from 18 to 50dB without disturbing the balancing; maximum input signal level at minimum gain is over one volt. Up to 48V of phantom power can be added for use with capacitor microphones.

The signal is applied to the microphone amp via tip-ring-sleeve input jacks (more economical than XLR types). The RC network sets the 1200-ohm input resistance and isolates the amplifier from any phantom-power DC, which is applied between chassis ground and the series resistor shown (the 6 to 7k value listed is ideal for +48V microphones). The signal is amplified with respect to ground by means of two identical transistor-op amp stages, which are optimized for best noise performance; the gain control is a pot in series with a common feedback path. If a linear pot is used, the gain will increase with counterclockwise rotation.

The still-balanced signal is applied to the third op amp, which converts it to an unbalanced signal, plus adding 15dB of gain (for a maximum a total of 50dB). The fourth op amp in the quad package is not used and is strapped out; it is available for use if needed.

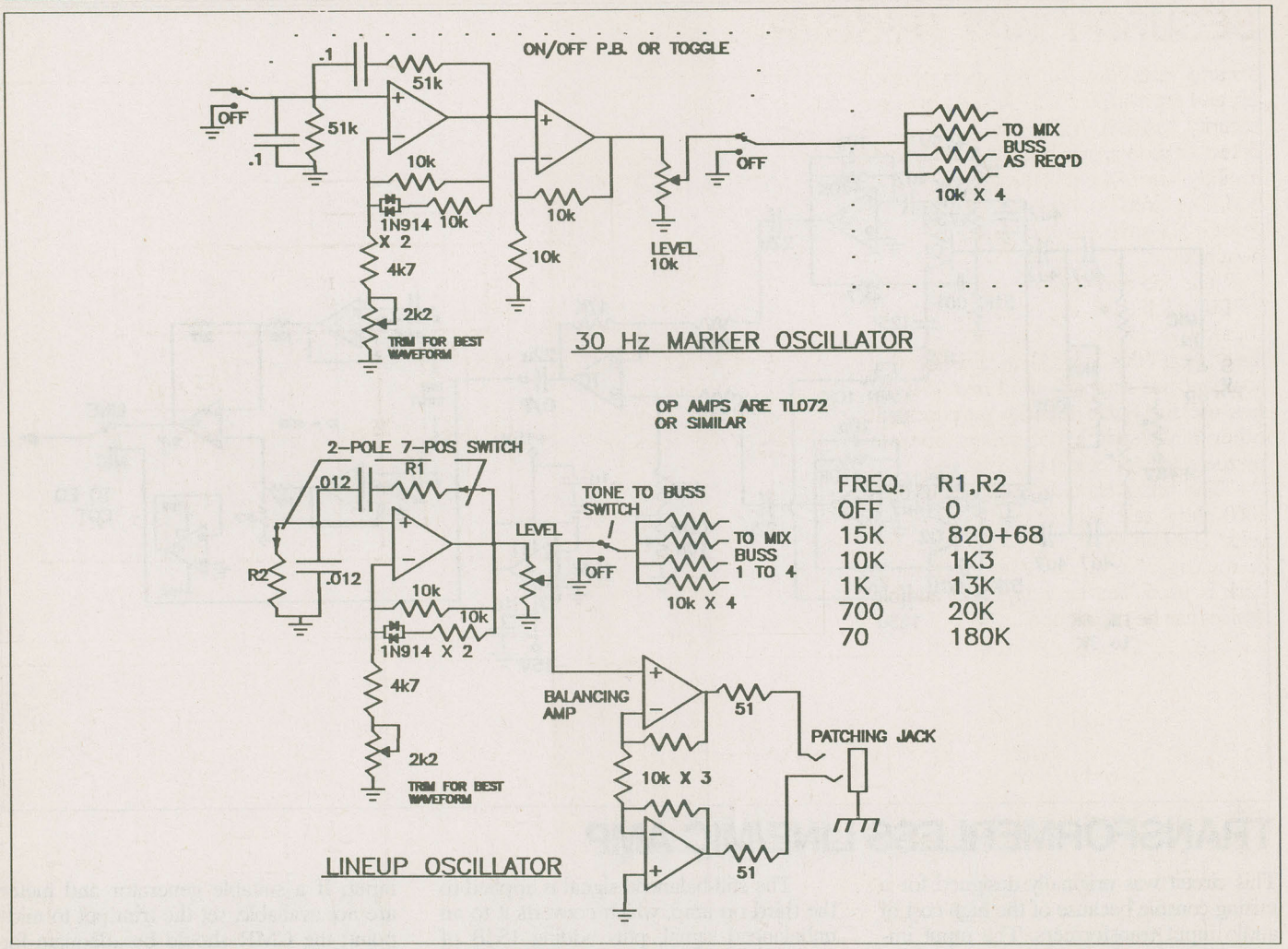
The line amplifier functions in much the same way as the unbalancing amplifier above, except that the third amp acts as an attenuator, giving a loss of about 9dB; this allows very high line levels to be applied to the line input without overload distortion, and also matches the incoming line level to the much lower operating level of the console. The line input impedance is high impedance, about 94k. If an unbalanced tape recorder is used, the line input can be replaced with a simple L-attenuator (10k in series with 2700 ohms, or other values to suit your operating level).

Adjustments: to set the microphone balancing (Common Mode Rejection), apply a short circuit across the input from Tip to Ring. Apply a signal of about 1kHz between Tip and Ground. Adjust the CMR trim pot until the output falls to a minimum; it should be possible to null out the signal to less than 70dB below the input. If a suitable generator and meter are not available, set the trim pot to midpoint; the CMR should be adequate for most purposes until the equipment is obtained.

No adjustment of the line level is required; 5% resistors should give common mode rejection exceeding 40dB, adequate for line levels. The gain or loss of the line amp is set by the top 2700-ohm resistor; the gain equation is simply R/10K, where R is in place of the 2700-ohm feedback resistor.

The op amps used are 4136 quad ICs, but separate ICs could be used. The transistors are any low-noise NPN, such as BC549 or equivalent. The biploar supply voltages should be between 12 and 15 volts.

The gain pot should be front-panel mounted for convenience, although a trim pot could be used if a fixed gain is acceptable. If clicks are heard when the Line/Mic switch is operated, connect a 100k resistor from the switch's Mic terminal to the circuit ground. If radio pickup on the microphone lines is a problem, the .001 RF suppressor capacitors can be increased to as high as 5000pF. In severe cases, add 470pF capacitors from the inputs to chassis ground.



MARKER/LINEUP OSCILLATOR

Both the above circuits are indispensable in the recording console. The **Marker Oscillator** at the top produces a 30Hz sine wave; this tone is injected into the console's outputs (or its talkback-to-tape circuit) when the operator is slating takes with the talkback microphone (*"Beethoven's Ninth*, Take 37"). When the tape is moved in fast-forward or reverse, the 30Hz tone (which is normally barely audible) appears as a much higher pitched sound, allowing the operator to tell instantly when a take has gone past.

The left-hand op amp is configured as a standard Wein bridge oscillator; the operating frequency is set by the two 51k resistors and the two 0.1u capacitors. Amplitude stabilization is set by the two 1N914 diodes in inverse parallel; when the amplitude begins to rise, the diodes will conduct and stabilize the gain.

The following op amp has 6dB of gain, producing an adequate output signal. The output level pot, which can be any value from 1k to 25k, applies the signal to the output mixing busses; four outputs are shown, though one to sixteen could be used. The 10k mixing resistors are a typical value which should work with almost any type of mix buss; they can be changed to suit if necessary.

To set the waveform, connect a scope to the output and adjust the trim pot until minimum distortion is seen. If you don't have a scope, listen to the output at a fairly loud level and adjust for minimum audible distortion (this isn't a low-distortion oscillator by any means, but it's simple).

The op amps can be any general-purpose duals or singles; the circuit shown uses TL072 types.

The Lineup Oscillator — proper operation of the tape machine, such as best signal to noise and flat response, often depends on how well you adjust the fine-tuning controls for various tapes (once the playback response is set to a professional-quality test tape).

This oscillator allows proper alignment of recording response, and also is invaluable for troubleshooting. It produces five of the more popular sine waves for testing, with Off positions at both ends. More can be added; see below.

The first op amp is a simple Wein bridge as described above. Five pairs of resistors are switched in and out of the circuit to change frequencies. To add more, note that the reactance of the capacitor is equal to the resistor at the frequency of interest: $R = 1/(6.28 \times C \times f)$, where C is in microfarads and f is in Hertz.

The level pot, which can be any value from 1k to 25k, feeds the signal to the mix busses by way of 10k mixing resistors; change these as necessary to suit the console.

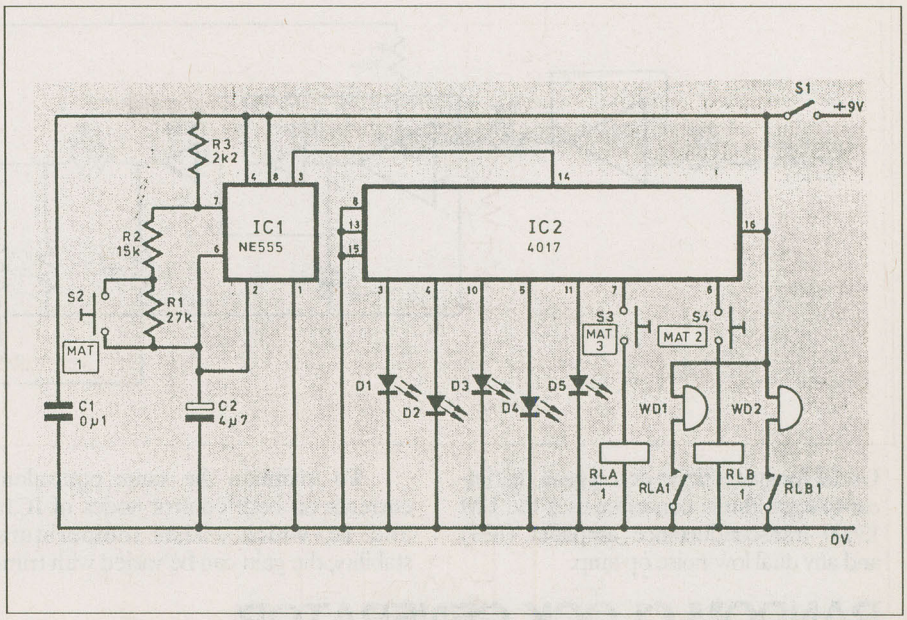
If your console uses balanced patching, you can add the balanced output as shown. It converts the single-ended signal to a balanced tip-ring-sleeve output.

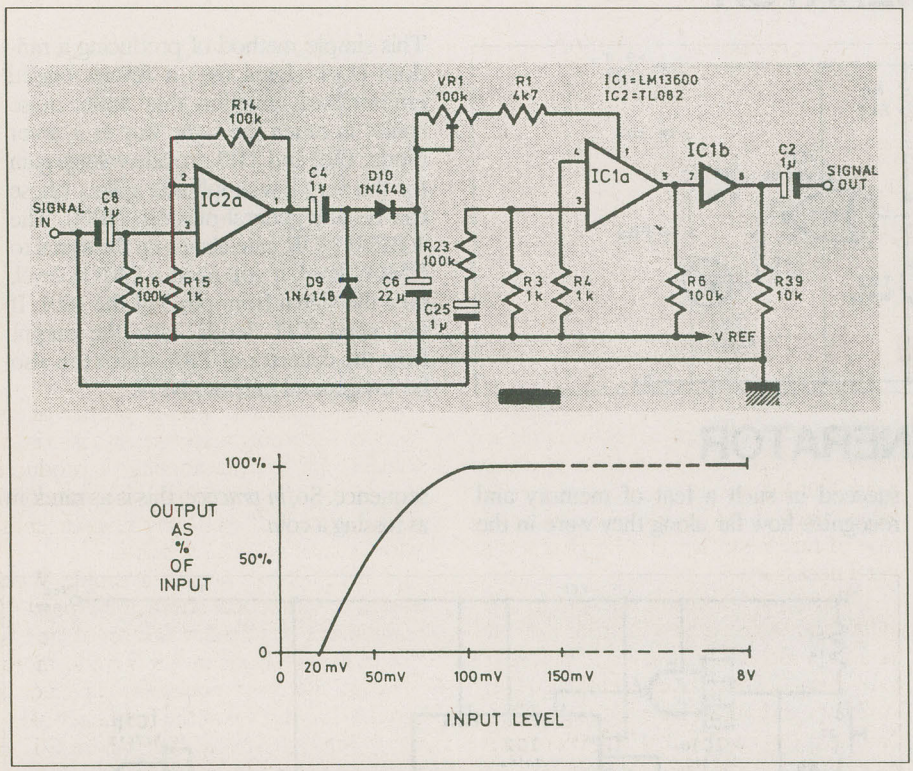
SECURITY MAT TRIGGER

Security mats close a circuit when stepped on, and are available from dealers in home security systems. They can be used to detect intruders, or to monitor children or invalids who shouldn't be getting out of bed. The circuit can also be used with any circuit closure device, such as door switches.

The 555 and 4017 decoder drive five LEDs which flash at a slow rate when on standby. If one mat is triggered, the array speeds up (this is used to indicate that someone has stepped out of bed – it has less use for home security purposes). If other mats switch on, relays operate piezoelectric (or other) buzzers.

The relays should have coils of 500-1000 ohms and operating voltages of 6-9 volts. The battery should be a 9V alkaline or rechargeable; if a line-operated plug-pack is used, heavier relays and audible devices can be substituted.



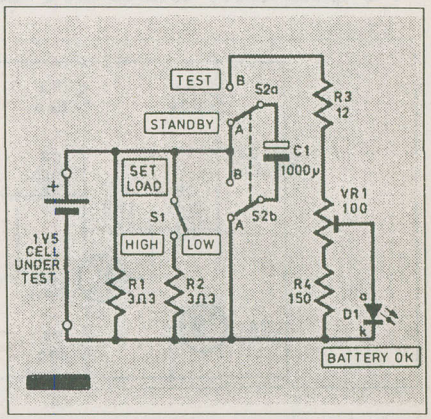


SIMPLE NOISE GATE

A low-noise op amp (TL072, TL082, etc) and an LM13600 transconductance amplifier make up a simple noise gate, which shuts down the audio path in the absence of signal. When a signal is detected, the gate opens.

During high signal levels, capacitor C6 is kept charged and the gate is open. When the signal falls below threshold levels, the voltage on C6 decreases and the gain is progressively lowered.

The accompanying diagram gives the typical threshold levels, showing the percentage output as the input rises from 20mV (no output) to 100mV (full output).

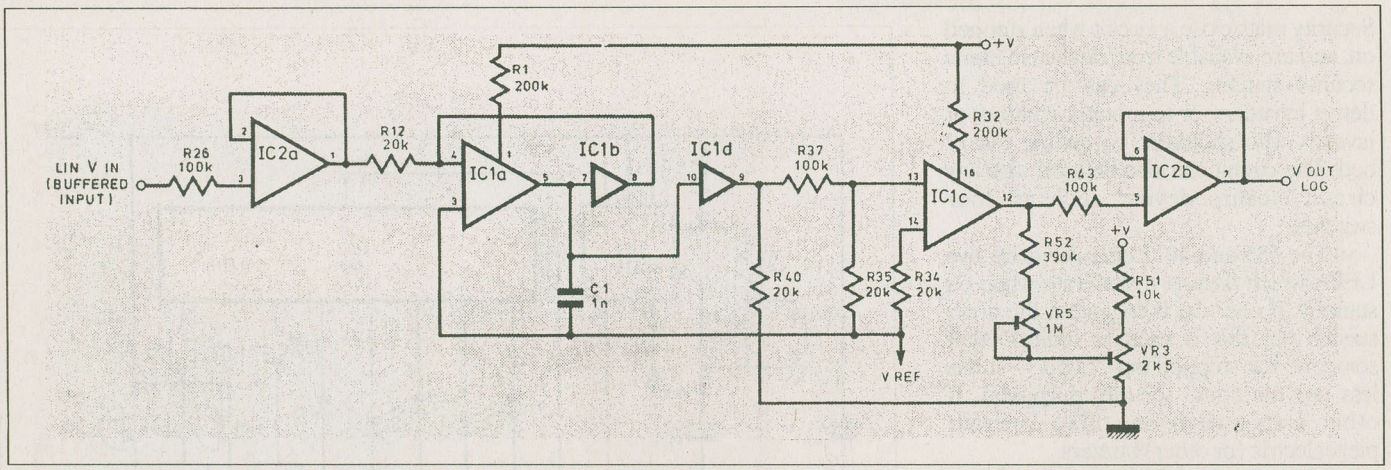


BATTERY TESTER

Testing a battery with a voltmeter isn't a particularly good test, since the battery voltage can still be quite high if no load current is being drawn. This circuit tests 1.5V batteries by draining about 400mA in the *Low* position and about 800mA in the *High* position.

Since a red LED requires about 1.6V to operate, C1 is switched as a voltage doubler. To adjust VR1, it's easiest to have one good cell and one that's run down but not completely dead. Test the good cell to confirm circuit operation, then test the run-down cell while adjusting VR1 until the LED just fails to flash. It may need some tinkering until you get reliable operation; since the LED does not switch sharply, some interpretation is needed – you'll find that the LED stays on over a fairly large adjustment of VR1.

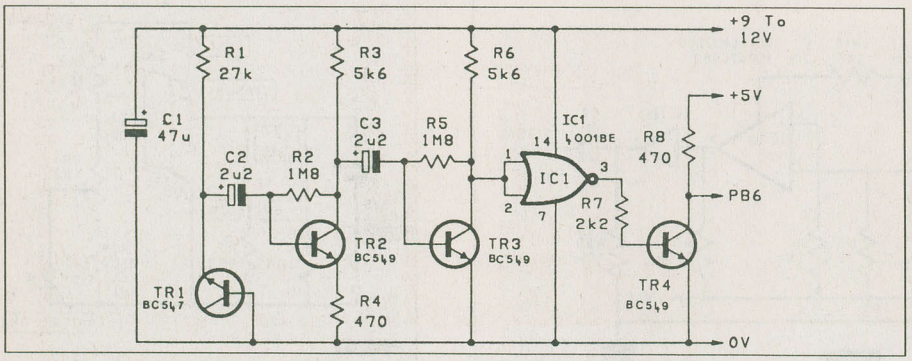
LIN/LOG CONVERTER



Useful for synthesizers or test gear, this linear-to-logarithmic converter uses the LM 13600 transconductance amplifier (IC1) and any dual low-noise op amp.

To maintain the same equivalent currents on both control nodes of IC1a and 1c, which assists temperature stability, the gain can be varied with trimmer VR5 to change the load factor at the output of IC1c. The overall voltage range can be shifted up or down by adjusting trimmer VR3.

RANDOM CLOCK GENERATOR



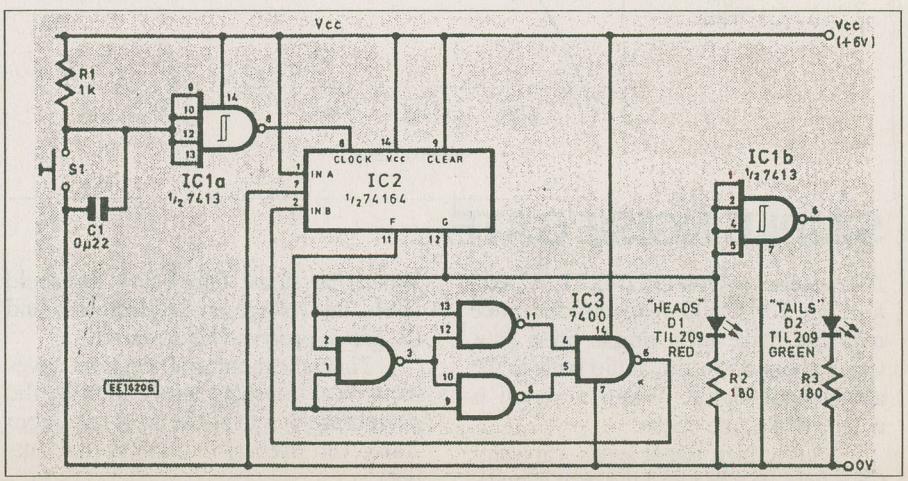
This simple method of producing a random clock signal uses a reverse-biased emitter-base junction that emits noise spikes in much the same way as a zener diode. TR2 and TR3 provide voltage gain for the very low-amplitude spikes (these can be any general-purpose NPN). The 4001BE NOR gate cleans up the signal to CMOS level; if you need a CMOS level, take the signal from pin 3 of the 4001. If you need TTL levels, take the output from the collector of TR4, which can also be any general purpose NPN.

PSEUDO-RANDOM GENERATOR

This circuit generates a psuedo-random sequence of 1s or 0s ("heads" or "tails"). It's based on a 7-bit shift register with the output taken from register *G*. If the output is high, the *Heads* LED is lit; a low output lights the *Tails* LED. It's slightly biased: since the 0000 state is not allowed, 127 "tosses" results in 64 heads and 63 tails.

IC1a, a 7413 dual Schmitt trigger, debounces the switch contacts and clocks the 74164 register one step. The EX-OR gate is made from four 7400 NAND gates. The other half of the Schmitt trigger, IC1b, is used as an inverter to turn the green LED on when *G* is low.

Remember that the sequence is only pseudo-random, not truly random. In theory, you could memorize it and be able to predict the next result. But it's highly unlikely that any normal person could succeed in such a feat of memory and recognize how far along they were in the sequence. So, *in practice*, this is as random as tossing a coin.



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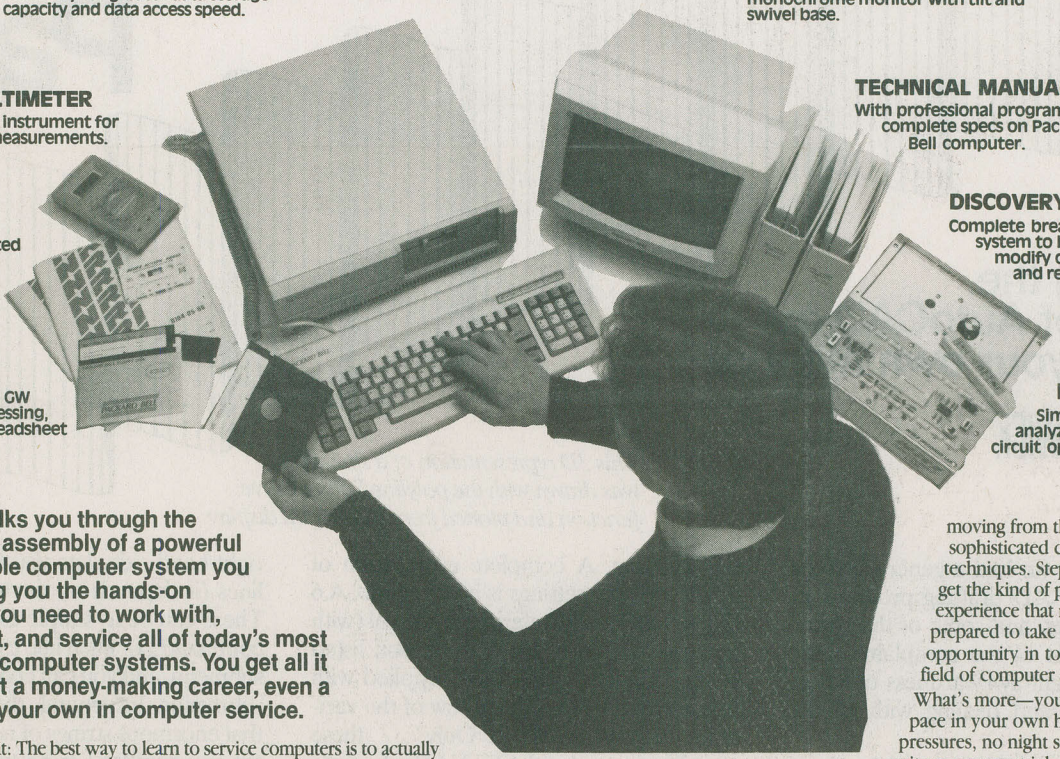

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AutoCAD for Electronics Part2

Tapping the power of AutoCAD by writing your own menus.

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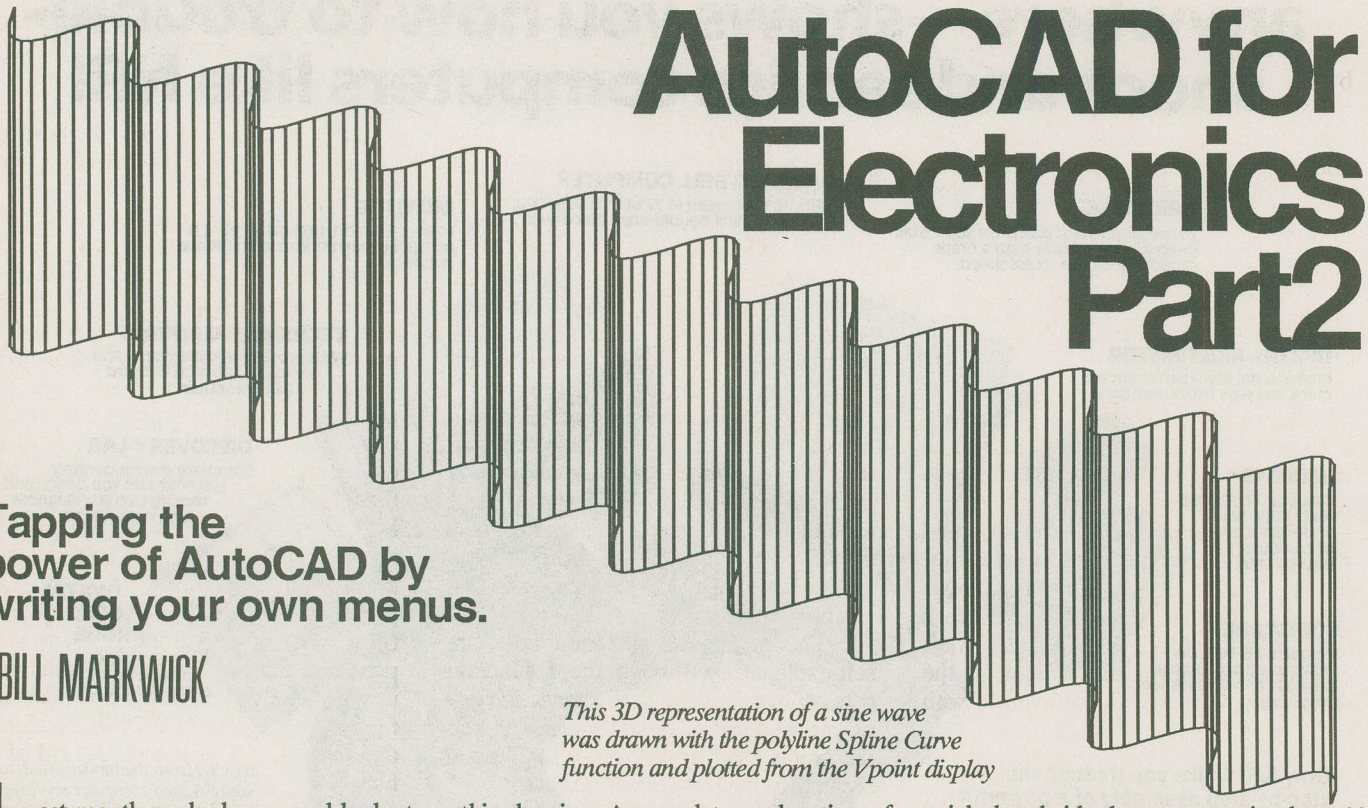

This 3D representation of a sine wave was drawn with the polyline Spline Curve function and plotted from the Vpoint display

Last month we had a general look at the AutoCAD drafting program, its enormous power, and some of the objections to it. Most of the complaints arise from the apparent awkwardness of entering commands and dealing with all the default settings.

In this issue, we'll look at solving those problems by means of custom menus. AutoCAD lets you rewrite all the menus: the onscreen menu (and submenus), the pulldown menus (Release 9 or 10 only) and the tablet menus (for digitizing tablets). Restructuring the commands and defaults to suit your sense of logic will make AutoCAD buzz along at dizzying speeds. It's safe to say that if you're using the program as it comes from the box, you're only tapping into a small part of its power.

A Recap

As we mentioned, the first thing to do before writing menus is to set the variables to suit you. This means that each new drawing will come onscreen with the snap and grid set to your preference, the blipmode off (or on), the text size set, and any other variables reset the way you like.

To do this, call up the template drawing ACAD.DWG, set all the variables you want, either directly or with the SETVAR command, and save the file. All new drawings will then have the same defaults as this drawing. A complete explanation of all the variable settings is in Appendix A.6 of the AutoCAD Reference Manual (with any new variables since publication listed in the Manual Supplement supplied with new releases). Note that a few of the variables display as "Read Only" — these can't be changed with SETVAR; also note that certain variable settings are stored with the individual drawing, not with ACAD.DWG — if you load a drawing and change the Blipmode to "On", for instance, that's what it will be every time for that particular drawing.

Loading Menus

During loading, AutoCAD is normally configured by ACAD.DWG to look for a menu file called ACAD.MNU, the one that comes with the software. If you've written your own, such as MY.MNU, you can make this the new standard by loading ACAD.DWG, typing MENU, entering your new menu name and saving. Or, if you prefer specific menus for specific tasks, you can change them at any time by typing MENU from your drawing file. The three types of menus (screen, tablet, pulldown) can be typed into a single file so they all work at once, or you can make each one a separate file.

The Screen Menu

The screen menu, which appears down the right-hand side, lets you type in about 20 lines (it depends on the type of monitor). These can be as simple as your favorite 20 commands, or each line can be the title of a submenu, and you can continue nesting the submenus. In general, though, I've found that enormous strings of nested commands get you confused in no time; it's better to pick the most-often-used commands and structure them with no more than one level of submenus. Simplicity pays off. After all, the whole idea here is so that you can go faster with AutoCAD.

Here's the basic syntax for writing screen menus (use a word processor with ASCII output, such as WordStar in the N mode).

```
***SCREEN
LINE
Endp
Perp
ZOOM W
ZOOM A
(etc.)
***BUTTONS
;
```

The three asterisks tell AutoCAD the purpose of the menu (screen, pulldown, buttons, etc.). Note that spaces count as Returns (as do semicolons); though you can make the menu item any length, the onscreen display is truncated to eight

characters. The Buttons section makes sure that one of your mouse or digitizer buttons is the same as the Return key (Button #1 is always "Pick"); if you have more buttons available, the others can become other AutoCAD commands. For instance, my 4-button SummaSketch puck uses this:

```
***BUTTONS
;
[CANCEL]^C
GRAPHSCR
```

Button #1 is Pick, #2 is a Return, #3 is Cancel (Control-C), and #4 returns to the drawing editor from the text mode (same as the F1 key).

The above menu is the simplest, and will do if all you want is few common commands. However, the menu structure is actually a simple programming language that can feed default values to AutoCAD's command prompt; here's a look at the menu macros and what you can do with them.

Macros

To create an extensive command for the menu, it's only necessary to give it a title (up to six characters) and enclose it in square brackets. Let's say you wanted to Insert a lot of symbols and didn't care to type in any new default values; we'll call the new command Quick Insert, or Q. INS:

```
[Q. INS]^CINSERT\\;;;
```

The name Q. INS will appear on the screen menu. When you select it, the Control-C cancels any command in progress (a good idea, putting Control-C before each macro). The left backslash allows user entry, in this case the Block Name and Insertion Point. The three semicolons act as Returns, accepting the next three defaults (size, aspect, rotation).

That's about it for basics. You can make each macro as long or as short as you need.

Symbols and Submenus

Here are the symbols used in AutoCAD's menu macros:

```
[xxx] onscreen title
; (or Space) Return
' (apostrophe) transparent
*** menu title
** submenu title
$x=menuname activates submenu
$x= deactivates a submenu
\ pause for text or Pick entry
+ macro continued on next line
^ make following char. ASCII
control code
```

The screen title is self-explanatory and should be kept under six characters; spaces are permitted. The semicolon should be used whenever you think AutoCAD may not insert a needed Return; for instance, ERASE \; waits for you to pick an object and then erases it — without the final semicolon it would simply wait after the object selection.

The apostrophe turns certain commands into transparent commands; *ie*, they can be used inside other commands. 'ZOOM and 'PAN will let you move around the drawing in the middle of a LINE command, for instance. Type HELP for a listing of the commands that can be used transparently.

The menu and submenu titles are self-explanatory, though the $ function gets confusing. It's used to change the display to a submenu and back again. Here's the syntax used to go from a small main menu to a small submenu and back:

```
[LINEMENU]$S=LINE_MENU
SNAP
GRID
etc

**LINE_MENU
Line
Pline
Pedit
Endp
etc
[PREV]$S=
```

If you're at the main menu and select LINEMENU, AutoCAD looks for a submenu called **LINE_MENU and displays it (the underline character is used only for clarity).

If you then select PREV, you'll be back at the main menu.

The \ is inserted whenever you want the program to pause for user entry; for instance, whenever the activated command says "Select Objects:" or "Text:" or similar. The + is used at the end of a line when you want to continue the macro on another line without invoking a Return keystroke.

The ^ (caret) will convert the next character into the equivalent ASCII control code. For instance, if you type ^C, AutoCAD converts this to an actual Control-C (ASCII 03). Another example: type ^G and it's converted to CRTL-G, the Grid On/Off toggle (same as function key F7).

For more information, see Appendix B.2 in the AutoCAD Reference Manual. To really get the hang of it, as with any programming, you need to write something and then debug any problems. The usual difficulty with AutoCAD macros is that the macro steps may not be in sync with the command prompt. Make sure the proper number of Returns are included, which is the number one cause of problems. Another cause that doesn't show up immediately is putting your text editor into the document mode rather than the ASCII mode, which may add high bits or headers that AutoCAD doesn't understand. To see if this has happened: TYPE your file from the DOS prompt. You should be able to see if funny things have been added. Your word processor may be able to deal with this — in WordStar, for instance, reload the file in the N mode and use CRTL-B to reformat the entire file. This should get rid of the high bits.

Fig. 1 is a listing for a typical screen menu. I've put in the commands I would use, and they probably won't suit you. Feel free to edit the commands all over the place — it's really meant as an example of how the menu syntax works.

Before going on to the next section, here's an example of how you can draw with macros; it produces a rectangle on the screen:

```
[BOX]LIMITS;0,0;12,9;LINE;1,1;1,4;8,4;8,
1;C;
```

After it draws the box, the Limits will remain at the default value of 0,0 (lower left) and 12,9 (upper right). If you're using other values, you may want to restore them.

Pulldown Menus

Before wasting any time trying these out, you should make sure that your program and monitor configuration can support pulldowns (versions prior to Release 9 will not, some monitors may not). If you're using the AutoCAD ACAD.MNU, move the mouse or digitizer up into the top line of the screen; you should be able to pull down the default menus. If you don't get these menus, your setup may not support pulldowns. As a last check, type SETVAR POPUPS. If it returns a 1, you're in. If it returns a zero, or an error message, you're

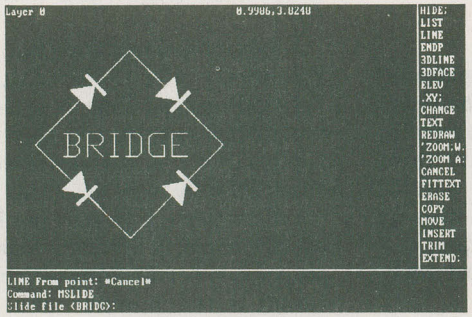

Fig. 3. To make the slide files for your icon display, call your block drawings into AutoCAD, make them fullscreen size and use MSLIDE to make the files.

```
res
cap
elcap
npn
pnp
opamp
bridge
LED
diode
pot
dot2
dot
jump
arrow
gnd
CANCEL
```

Fig. 4. Now make an ASCII file with a text editor, listing each icon slide file on a separate line. Now use the SLIDELIB utility as described in the text to make a library.

```
***ICON
**IPARTS
[COMPONENTS]^C
[COMPLIB(res)]^Cinsert res
[COMPLIB(cap)]^Cinsert cap
[COMPLIB(elcap)]^Cinsert elcap
[COMPLIB(npn)]^Cinsert npn
[COMPLIB(pnp)]^Cinsert pnp
[COMPLIB(opamp)]^Cinsert opamp
[COMPLIB(bridge)]^Cinsert bridge
[COMPLIB(LED)]^Cinsert led
[COMPLIB(diode)]^Cinsert diode
[COMPLIB(pot)]^Cinsert pot
```

Fig. 5. Add this section to your MNU file as described in the text.

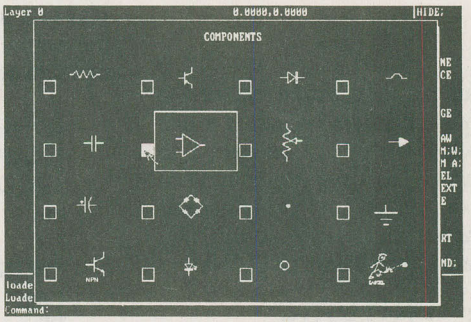

Fig. 6. You've got icon menus!

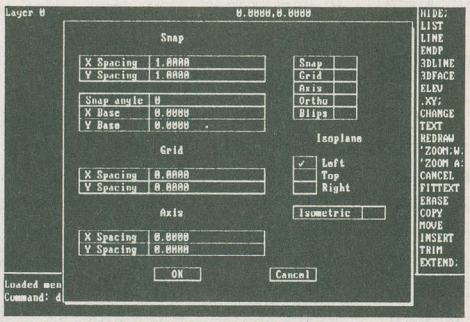

Fig. 7. One of the dialogue boxes provided by AutoCAD and called from a menu. with DDRMODES.

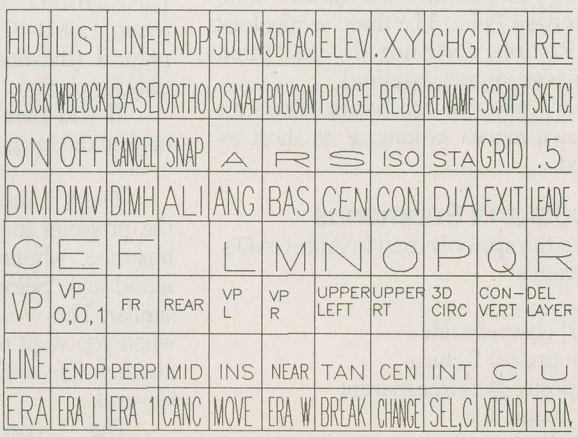

Fig. 8. A section of a custom digitizing tablet menu, about actual size. It's taped to the top of the tablet.

Fig. 1. A sample listing that will produce a Screen menu in AutoCAD. It's only one of the many ways you can arrange the commands and command structure; in this case the nesting never goes beyond one submenu, so it's easy to find your way around. Note: do not type in the {REM} markers or the comments that follow them.

```
***SCREEN {REM} sends commands to right side of screen
^CLINE {REM} the ^C cancels any command in progress
^CERASE
OOPS
UNDO
^CMOVE
'ZOOM W {REM} apostrophe lets you zoom inside other commands
^CLIST
^CINSERT
^CCOPY

[CANCEL]^C^C {REM} end of screen main menu

[LINEMENU]$S=LINEMENU {REM} these five are submenus
[DISPLAY]$S=DISPLAY {REM} and do not appear onscreen.
[EDIT]$S=EDIT
[3D]$S=3D
[LAYERS]$S=LAYERS

**LINEMENU {REM} first submenu for Line-related commands
^CLINE
^CPLINE
^CPEDIT
Endp {REM} these three allow one-time Object Snap
Int
Perp

ERASE
OOPS

^CARC
^CCIRCLE
^CELLIPSE
^CSKETCH
^CARRAY
^CLINETYPE
^CPOINT

[PREV]$S= {REM} returns you to main menu

**DISPLAY {REM} the second submenu
'ZOOM {REM} Zoom commands can be used inside other commands
'ZOOM P
'ZOOM A
'ZOOM W
'PAN
[VU SAVE]^CVIEW S
[VU REST.]^CVIEW R
[VU DEL]^CVIEW D
REDRAW
REGEN
```

(continued)

(Continuation)

```
[PREV]$S= {REM} returns you to main menu


**EDIT {REM} third submenu
^CERASE
^CERASE W
^CMOVE
^CMOVE W
^CCOPY
[MULTCOPY]^CCOPY;W;\\;M {REM} the \ allows user entry
^CINSERT {REM} the ; is the same as Return
^CMINSERT {REM} or Space
^CTRIM
^CEXTEND
^CBREAK
^CSELECT
^CCHANGE
^CROTATE
^CEXPLODE
^CMIRROR
^CSTRETCH
^CPEDIT

[PREV]$S= {REM} returns you to main menu

**3D {REM} the fourth submenu
^CELEV
^CLINE
^C3DLINE
Endp
.XY
^C3DFACE
^CSOLID
[PLAN VU]^CVPOINT;0,0,1 {REM} the next three send values
[UPPER RT]^CVPOINT;-2,-2.5,2 {REM} to the Viewpoint
[UPPER LT]^CVPOINT;-2,2.5,2 {REM} command

[PREV]$S= {REM} returns you to main menu

**LAYERS {REM} the fifth submenu
^CLAYER
[LIST]^CLAYER;?;;;
[THAW]^CLAYER T
[FREEZE]^CLAYER F
[NEW]^CLAYER N
[CHANGE]^CLAYER S

[PREV]$S= {REM} returns you to main menu

***BUTTONS
; {REM} makes Button 1 the PICK button and Button 2
  {REM} becomes a Return. Buttons 3 and 4 can be added
  {REM} as necessary.
```

out of luck.

Assuming that all goes well, and that you'd rather have your own menus than the ones supplied by AutoCAD, you can either add the new pulldown menu onto our Screen menu as described above, or you can write a separate file for pulldowns only.

You can have up to ten main headings; each pulldown can have about 20 lines (it depends on your monitor); each pulldown can also have submenus. Here's the basic structure:

```
***POP1
**P1A
[MAIN MENU]
Line
Pline
Endp
etc
[SUBMENU B]$P1=$P1B $P1=*
[SUBMENU C]$P1=$P1C $P1=*

**P1B
[SUBMENU B]
ZOOM A
ZOOM W
PAN
[EXIT]$P1=P1A

**P1C
[SUBMENU C]
ERASE
OOPS
UNDO
[EXIT]$P1=P1A
```

In this demonstrator I've used Line, Endp, etc. as filler – you can substitute macros of any length just as you did with the Screen menu. Also: you can finally use names of a decent length – the pulldown window will just expand to accommodate long ones.

In the example, the pulldown window that's being displayed is labelled $P1, so for instance, $P1=$P1B means that submenu $P1B is the one on the screen. When you're finished with the menu, select EXIT to return to the main window; otherwise the submenu disappears but remains active. $P1=* is a command that means "display the selected menu". Without it, the selected menu becomes active but doesn't immediately appear. Note: if the submenu is small, it will not completely overwrite the main menu, but will merge with it. To prevent this, fill up the submenu with blanks by using a right and left bracket [].

That's about it; the macro structure is identical to the Screen type. **Fig. 2** is a listing of a workable pulldown menu that gives two windows, FILE and DRAW, plus some submenus in the DRAW function. As I mentioned, it's only one of an infinity of ways to structure the commands: edit away until it suits you.

Icon Menus

This is where it gets really interesting. This is where you call your colleagues in to look at your custom-made icons, and word begins to spread that you're King CAD.

Besides that, they're very efficient to use, especially with large symbol libraries. Let's assume that you have a number of DWG files of electronic components that you use with the INSERT command, and that you want them to appear onscreen so you can make your choice (rather than typing the block filename each time).

Note that in the pulldown listing of Fig. 2, I've included the line [COMPONENT ICONS]$I=IPARTS $I=*. When selected, this macro sends AutoCAD looking for a Slide file library of my electronic component Blocks. When found, it's displayed full-screen. I can then pick any component from the symbols that appear, and the Icon function runs the Insert command automatically, drawing the component from the DWG library.

The nice thing about it is that you just give AutoCAD any number of slide files – it draws the boxes and figures out how to display them neatly. I've used 16 icons, which AutoCAD arranges in a 4 by 4 grid; you can put more, but the images get smaller and smaller.

Here are the steps:

1. Insert the $I= macro in your pulldown as described.

2. Decide on what drawings you want displayed in the icon box; call them into AutoCAD one at a time. Expand them to full screen size and type MSLIDE, giving a suitable filename. This captures whatever drawing is on the screen as a file with the extension .SLD. See **Fig. 3.** Note that AutoCAD does not name the icons – if you need a label, add it to your drawing before making the slide file.

3. Make an ASCII file listing each slide on a new line, with or without the extension .SLD. Call it TEXTFILE or similar. See **Fig. 4.**

4. Check to see that you have the file SLIDELIB.EXE that comes with Release 9 and later. From DOS, type SLIDELIB COMPLIB <TEXTFILE. Now the SLIDELIB program will follow the list in TEXTFILE (because of the left arrow, a DOS redirection symbol) and condense the slide files into one library file (COMPLIB.SLB).

Check to see that you have the file COMPLIB.SLB (for Component Library – you can call it anything else you like, as long as it terminates in .SLB). This compact list of the slide files will load rapidly into our pulldown icon menu. It's much better than having AutoCAD load each slide file separately. The SLD slide files are no longer needed and can be deleted once you prove that everything's working.

Lastly, I've added the following lines to the end of my pulldown menu (to make your own icon menu – substitute your slide library filename for COMPLIB, and your component names for mine):

```
***ICON
**IPARTS
[COMPONENTS]
[COMPLIB(res)]insert res
[COMPLIB(cap)]insert cap
[COMPLIB(elcap)]insert elcap
[COMPLIB(npn)]insert npn
[COMPLIB(pnp)]insert pnp
[COMPLIB(opamp)]insert opamp
[COMPLIB(bridge)]insert bridge
[COMPLIB(LED)]insert led
[COMPLIB(diode)]insert diode
[COMPLIB(pot)]insert pot
[COMPLIB(dot2)]insert dot2
[COMPLIB(dot)]insert dot
[COMPLIB(jump)]insert jump
[COMPLIB(arrow)]insert arrow
[COMPLIB(gnd)]insert gnd
[COMPLIB(CANCEL)]^C
```

The filename in round brackets is the one used in the ASCII list and calls the slide file from the library; the block name at the end of each line calls the block from your disk and inserts it in the drawing.

Now when you pull down your DRAW menu and click on Component Icons (or whatever name you're using), the screen will fill with a grid of icons; select the one you want, the menus disappear and the desired block should be onscreen, ready to be inserted.

DDMODES

There's one more feature that can save you a lot of time: the dialogue box. This function is provided with Release 9 and 10 and calls up a screen box full of options that can be selected with the cursor (Snap On/Off, Ortho On/Off, Grid, and many others). You can also type in new values for the

Fig. 2. This is an example listing that will generate pulldown menus in AutoCAD Release 9 or 10. The first SCREEN section allows commonly-used commands to appear at the right edge of the screen; if this menu is merged with the menu of Fig. 1, the SCREEN section below can be deleted.
Note: do not type in the {REM} markers or the comments that follow them.

```
***SCREEN {REM} commands that appear on the right screen menu.
LINE    {REM} Add or replace commands to suit.
Endp
PLINE
ERASE
UNDO
MOVE
CHANGE
COPY
ZOOM W
ZOOM A

***POP1      {REM} the first or leftmost pulldown menu
**P1-FILE
[FILE]       {REM} the menu name that will appear at the screen top
[SAVE, MAIN MENU]END
[SAVE AND RESUME]SAVE;;
[SAVE AS...]SAVE
[---]        {REM} produces dividing lines for clarity
[ABANDON]QUIT
[---]
[RUN DOS COMMAND]^CSHELL
[---]
[STATUS]^CSTATUS
[PLOT]PLOT E {REM} plots Extents; remove the E if desired
[PRPLOT]PRPLOT E {REM} Prplots Extents; remove the E if desired
[INSERT]^CINSERT
[QUICK INSERT]^CINSERT \\;;;  {REM} accepts all defaults
[BLOCK]^CBLOCK
[WRITE BLOCK]WBLOCK

***POP2 {REM} the second pulldown menu
**P2A {REM} the main part of the second menu
[DRAW] {REM} menu name that will be displayed
[ERASE WINDOW]^CERASE W
[UNERASE LAST]OOPS
[LINE]^CLINE
[LINE ENDP]^CLINE ENDP
[LINETYPE MENU]$P2=P2D $P2=* {REM} this displays P2D
[POLYLINE]^CPLINE
[EDIT POLYLINE]^CPEDIT
[COMPONENT ICONS]$I=IPARTS $I=*{REM} display icon
[POINT]POINT          {REM} if it exists; see text
[ARC]^CARC
[CIRCLE]^CCIRCLE
[ELLIPSE]^CELLIPSE
[UNDO]^CUNDO
[ARRAY]^CARRAY
[SKETCH]^CSKETCH
[FILLET MENU]$P2=P2C $P2=*  {REM} this displays P2C
[HATCH MENU]$P2=P2B $P2=*  {REM} this displays P2B

**P2B {REM} this is the P2B (Hatch) submenu          (continued)
[HATCH] {REM} this is the submenu name that appears on the top line
[HATCH]HATCH
[PATTERN LIST]^CHATCH ?
[HATCH, LINE]^CHATCH LINE
[DOTS]^CHATCH DOTS
[METAL SECTION]^CHATCH ANSI32
['WOOD']^CHATCH ANSI33
[BRICK]^CHATCH BRICK
[DASH]^CHATCH, DASH
[HOUNDSTOOTH]^CHATCH HOUND
[EXIT]$P2=P2A {REM} this recalls the main Draw menu
[] {REM} these blanks ensure overwriting of the
[] {REM} main menu by the submenu
[]
[]
[]
[]
[]
[]
[]
[]
**P2C {REM} this is the P2C (Fillet) submenu
[FILLET] {REM} this is the submenu name that appears on the top line
[FILLET]^CFILLET
[MULT FILLET]*^C^CFILLET;
[FILLET PLINE]^CFILLET P
[SET FILLETRAD]^CFILLET R
[GET FILLETRAD](GETVAR "FILLETRAD")
[CHAMFER]CHAMFER
[EXIT]$P2=P2A {REM} this recalls the main Draw menu
[]
[] {REM} blanks ensure overwriting of main menu by the submenu
[]
[]
[]
[]
[]
[]
[]
[]
[]
[]
**P2D {REM} this is the P2D (Linetype) submenu
[LINETYPE] {REM} the submenu name that appears on the top line
[LINESCALE]^CLTSCALE
[DOTTED LINE]^CLINETYPE SET DOT;;LINE
[DASHED LINE]^CLINETYPE SET DASHED;;LINE
[CONT. LINE]^CLINETYPE SET CONTINUOUS;;LINE
[SMALL DASH]^CLINETYPE SET HIDDEN;;LINE
[PHANTOM]^CLINETYPE SET PHANTOM;;LINE
[CENTERLINE]^CLINETYPE SET CENTER;;LINE
[BYLAYER]^CLINETYPE SET BYLAYER;;LINE
[SEE LINETYPES]^CLINETYPE ?;;
[EXIT]$P2=P2A {REM} this recalls the main Draw menu
[]
[] {REM} blanks ensure overwriting of main menu by the submenu
[]
[]
[]
```

Continued on page 45

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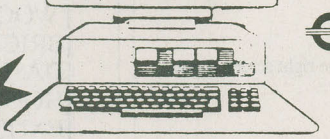

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Class One Sound Amplifier Part2

Constructional details for last month's audio amp.

GRAHAM NALTY

Last month we discussed the problems associated with amplifier design and looked at the circuit stages in detail. This month we conclude by setting out the construction procedure and final testing.

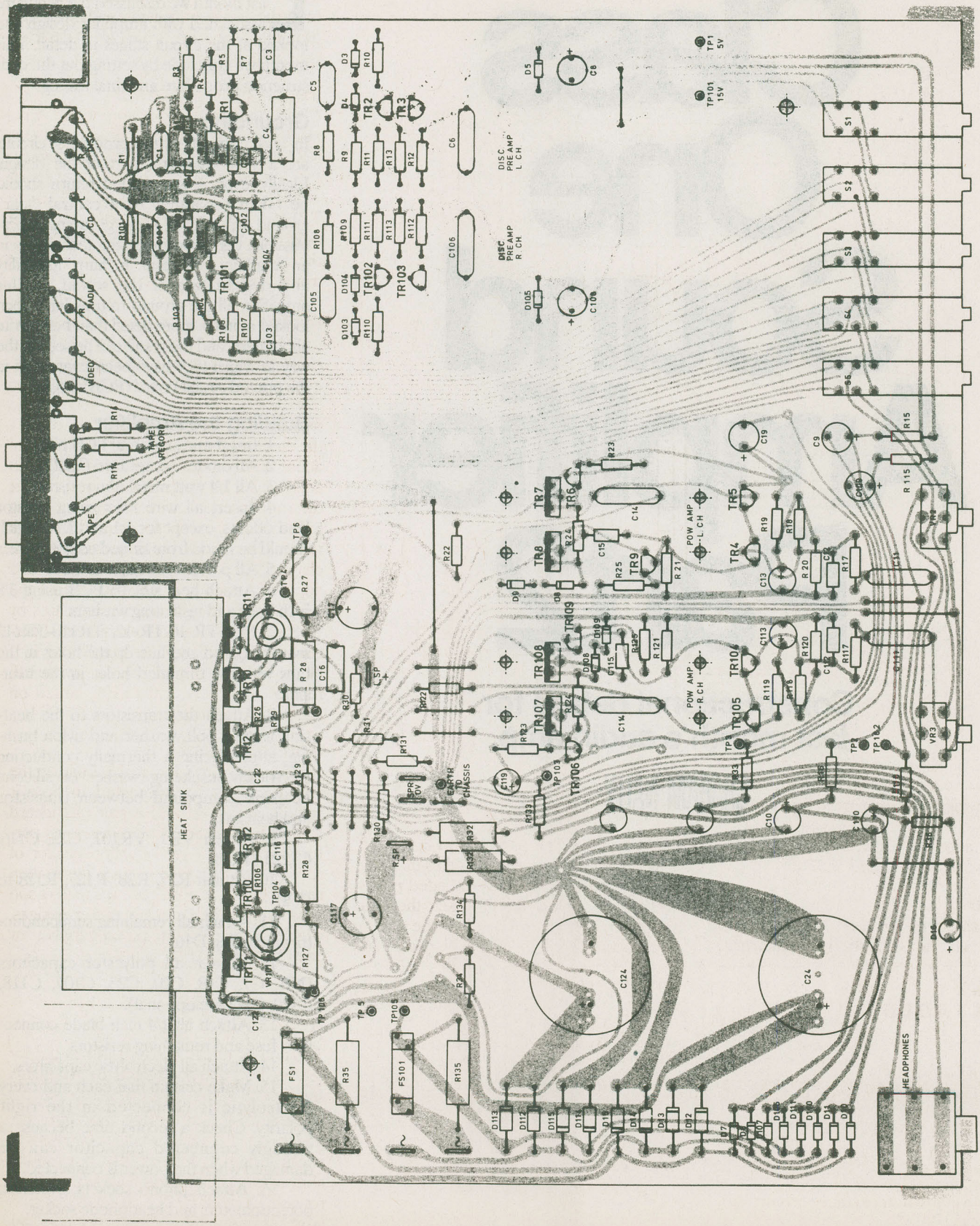
Grounding

In audio amplifiers the grounding circuits are a very important part of the design. Ideally, every single ground return should be taken separately to a central "star" ground. In practice, some grouping is permissible, but poor grounding techniques in an amplifier will result in hum, instability and degradation of the sound. In this amplifier, all the ground returns have been looked at in far more detail than I can write about here, and the result can be seen in the way in which they have been connected in the printed circuit board (PCB) layout.

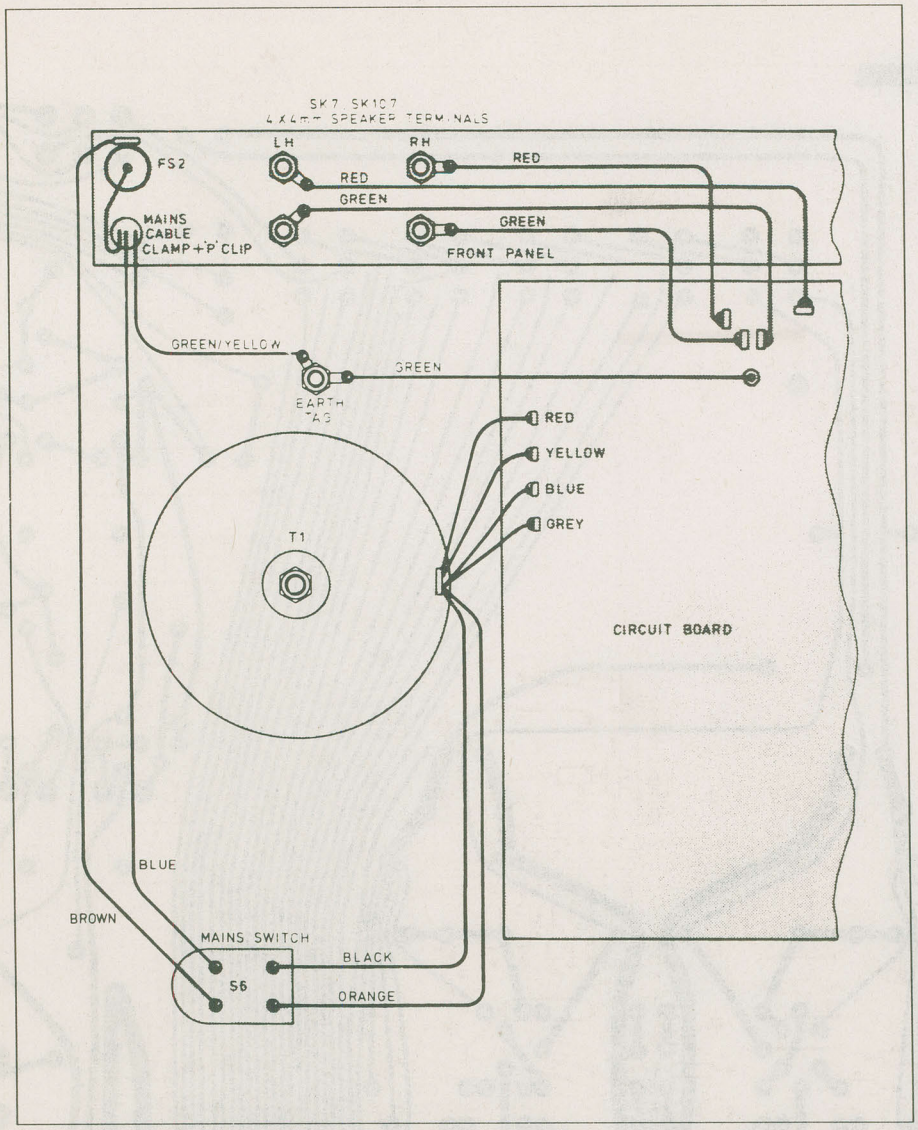
Building the Amplifier

1. Insert and solder all PCB pins.
2. All diodes except D16 (LED).
3. All 1/4 watt metal film resistors.
4. Insert all wire links using resistor lead offcuts, except for L1 and L10 which should be made from tinned copper wire.
5. All polystyrene capacitors.
6. Attach heat sink to PCB using 3/8 inch bolts and insulating washers.
7. Slot TR-10-TR-12, TR110-TR112 into the board and line up the holes in the tabs with the threaded holes in the heatsink.
8. Attach the transistors to the heatsink using a bolt, washer and nylon bushing, after placing a thermally conducting electrically insulating washer or silicone heatsink compound between transistor and heatsink.
9. Attach VR1, VR101, C22, C116, C122 to PCB
10. Attach R27, R28, R127, R128 to PCB
11. Attach all remaining semiconductors including D16.
12. Attach all polyester capacitors (NB, C7, C18, C20, C23, C107, C118, C120, C123 are optional).
13. Attach all 1/4 inch blade connectors, fuse and remaining resistors.
14. Attach all electrolytic capacitors.
15. Make certain that each and every electrolytic is connected in the right polarity. Check a second time because a wrongly connected capacitor can be damaged when the power is connected.
16. Attach phono sockets, switches, potentiometers and headphone socket.

Now that the board is complete, set



The printed circuit board component layout for the Class One amplifier, not full size.



Interwiring from case mounted components to the PCB.

VR1 and VR101 fully clockwise and remove fuses FS1 and FS101.

Case

Next assemble the case, leaving the rear panel off, and attach the mains transformer and all the parts shown in Fig. 11. The PCB can now be attached to the floor of the case using 3/4 inch threaded pillars with bolts at each end. Attach the rear panel to the case and make all the necessary connections to the PCB (Four 1/4 inch blade connections from the transformer, four 1/4 inch blade connections from the speaker terminals and the chassis ground connection, which is soldered to the 1mm dia. pin.

Testing the Amplifier

Check that fuses FS1 and FS101 have been removed from the board and that VR1 and VR2 are turned fully clockwise.

Switch on and measure the voltages at test points TP1 to TP4 and TP101 to TP104. The slightly lower readings on the right channel (TP101 to PT104) are due to the effect of the LED drawing current from the right channel supply only.

The most difficult part of building the amplifier is setting the output stage quiescent current. This is achieved on the left channel by turning VR1 counterclockwise, and on the right channel by turning VR101 counterclockwise. If you have a digital meter or oscilloscope you can set the current by turning VR1 (VR101) until about 40mV is observed across R27/R28 and R127/R128. Alternatively, you can set the output stage quiescent current using only a moving coil meter on its AC voltage range. Connect the meter across R35 (left channel) and R135 (right channel) and adjust VR1(L) and VR101(R) until the reading across each register increases by one volt AC. This will give a quiescent current of 20mA through the output stages. If all the readings appear correct, switch off, replace fuses FS1 and FS101, switch on again and start listening.

Sound Quality

Readers who are interested in building the amplifier will be interested in how it sounds, so I borrowed a pair of Richard Allen CD5 loudspeakers to assess its performance with a high quality speaker of recent design. The results were very rewarding. Stereo imagery was really good compared with one of my earlier designs, which shared the same power supplies for each channel.

Parts Availability

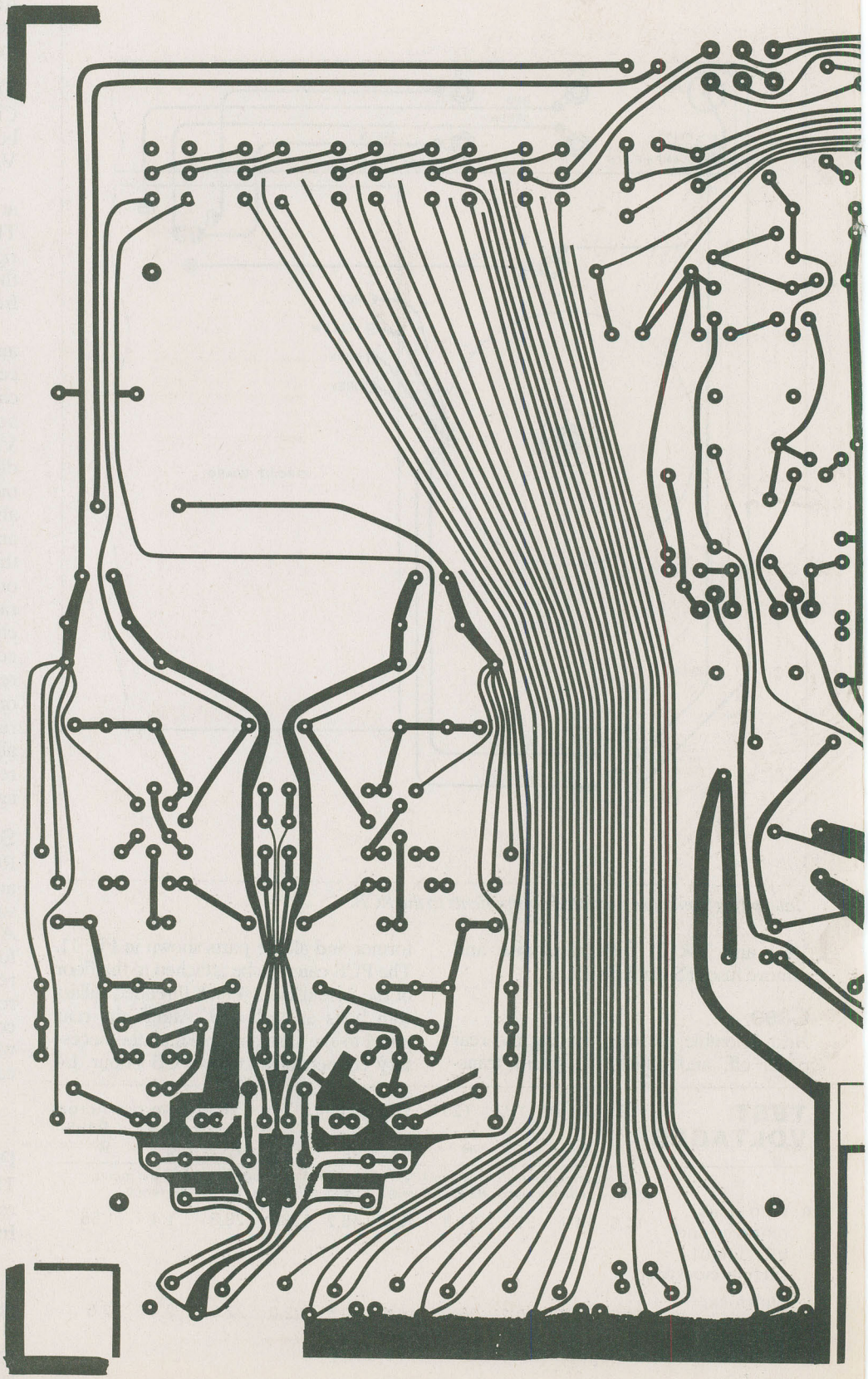
The printed circuit diagram is enclosed for reference; it is copyrighted by Audiokits Inc.

Complete amplifier kits, plus individual components, special component packs and printed circuit boards are available from Audiokits, 6 Mill Close, Borrowash, Derby DE7 3G0, England. Send a large envelope plus three International Reply Coupons for details.

TEST VOLTAGES

	TP1	TP101	TP2	T201	TP3	TP103	TP4	TP104	Across R35	Across R135
	L	R	L	R	L	R	L	R	L	R
A With fuses removed and VR1, VR101 set fully clockwise	14.5	14.7	31.5	31.3	45.7	45.2	23.2	28.8	1.4	1.55
B With fuses removed and VR1, VR101 set to 20mA output stage current	14.6	14.7	30.2	30.1	42.9	42.8	22.0	22.0	2.4	2.5
C With fuses inserted and 20mA output stage current	14.6	14.7	33.5	33.5	49.5	49.5	24.9	24.7		

* All measurements from TP1 to TP4, TP01 to TP104 are made using a digital meter. Measurements across R35, R135 with a moving coil meter on a.c. volts range.



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Ottawa: (613) 235-2378 Fax: 235-2416
360 Albert Street, Suite 1510, Ottawa, Ontario K1R 7X7
Edmonton: (403) 483-4271
Montreal: (514) 849-5872
Halifax: (902) 454-0052

TOLL FREE ORDER LINE AND SERVICE INFORMATION

1-800-668-6951

Warranty
All Exceltronix BEST computers are warranted for one full year covering both parts and labour at our central service facility in Toronto.

Optional On-Site Service
For those who want superior service coverage - (within 80km of one of 25 key service centres) - we can provide on-site service on any computer system for just $200 for the first year. Service available over 80km for additional surcharge.

Custom Configurations
This catalogue lists the most popular configurations of computer systems. However we will be delighted to quote on your specific needs.

Corporate Leasing and Employee Purchase Plans
We can arrange for leasing of most systems for just dollars a day. Call for details. Exceltronix has considerable experience in setting up complete employee puchase plans. On request, we can send you our information kit.

Government and Corporate Users
Are we on your tender list? If not, give us the opportunity to quote on your requirements. With our large selection of truly Canadian-made, top quality products, we can provide cost- effective and reliable systems. Quantity discounts are available for Governments and Companies.

Custom Design and Manufacturing
Exceltronix is much more than BEST computers and the products described here in our catalogue. We have our own highly qualified research and design engineers and manufacturing facilities. We are experts in CAD/CAM, digital sign technology and many other areas of electronics. We undertake all types of specialized projects: let us quote on your needs.

Employee/Student Purchase Plans
We have been very successful in the past at working closely with companies both for the installation of large numbers of systems and for employee purchase plans. Many companies appreciate the advantages of having computer literate staff and are helping their staff to buy personal computers. We have a great deal of experience in working with companies to set up such programmes and are able to offer worthwhile discounts for these quantity purchases. Ask for our free information kit.

Educational Market
BEST computers are ideal systems in the educational field. There are numerous installations of BEST systems in this market due to the compatibility with IBM and the excellent value for this cost conscious area. We are able to quote excellent discounts and provide superb service and technical support for the educational market.

Quality and Reliability
More than ever before, at Exceltronix, we are concentrating on quality, reliability and service. A significant part of our business comes from the personal recommendation of our customers; this means each product that performs perfectly is an excellent advertisement for another sale. Remember also that we are continually introducing new products, therefore prices and specifications are subject to change without notice. Exceltronix continues to grow rapidly in a very competitive market due to our commitment to quality, service and value.

Dear Exceltronix Customers,

It is with great pride and pleasure that we introduce our new 1989 computer product line. After being in the computer business for a decade, I can honestly say that our current product line is the most exciting we have ever presented.

We at Exceltronix offer you a superb line of products, designed and manufactured right here in Canada. Many of our engineering, technical and sales staff have in excess of 10 years experience in the computer business and have been involved in the design of various computers and computer boards - thousands of which are in use throughout Canada.

Some of the engineering staff were involved in designing products such as our Z80 Computer and are currently working on the new 486 computer line. They were also involved in the design and manufacture of the computerized digital signs in the Toronto Subway System, the Vancouver LRT and VIA rail cars as well as installations in airports and other areas of transportation.

Our strategy is to develop world class products using the latest technology, selling directly to customers whether they be large corporations or individual sales. There are no middlemen and therefore we offer you the most value for a competitive price. We are projecting our sales to exceed $25 million for this year and are proud to be a major supplier to the Canadian Government.

Exceltronix offers a full year of service on all BEST Systems. Our sales and technical support staff aim to ensure customer satisfaction. Our head office is located in Etobicoke (Toronto) and we also have offices in Edmonton, Downtown Toronto, Ottawa, Montreal and Halifax to serve you better. Third Party on-site service and depot service is available across the country.

If you require sales or service information, please do not hesitate to contact our new Toll-Free number, our head office at (416) 252-8543 or your local office (phone numbers are on the cover of the catalogue). Orders may also be FAXed to our Head Office at (416) 252-5124 or sent to 433 Horner Avenue, Unit 12, Etobicoke, Ontario, M8W 4Y4.

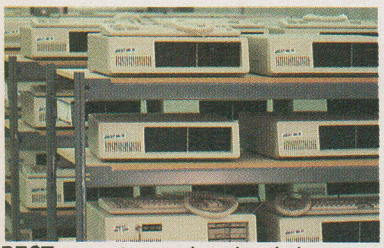
Exceltronix Computing Inc. is proud to be Canadian. Whenever possible we incorporate products designed and made in Canada. Be proud to support Canadian industry!

We thank the computer users for their continuing support; it is this support that has contributed to our tremendous growth.

Yours sincerely

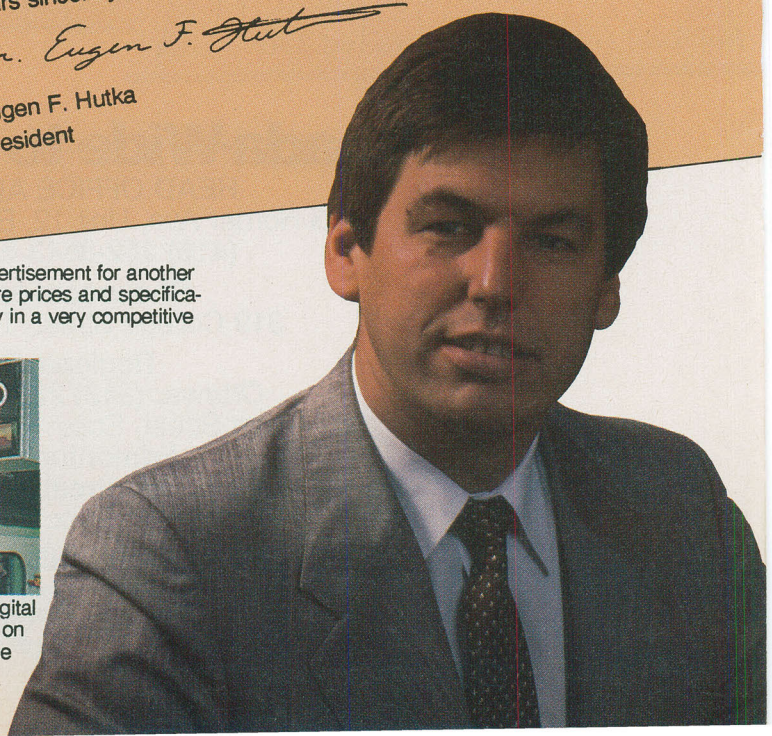
Per. Eugen F. Hutka

Eugen F. Hutka
President



BEST computers undergoing their rigorous 48-hour automatic testing prior to shipping.

Exceltronix is a major supplier of digital display signs including those used on the Toronto subway system and the Vancouver LRT Transit System.



BEST COMPACT 386-SX

"Since this machine has such extraordinary performance at such a low price, we believe it represents the best value in the market today."

This latest addition to our computer line features the Intel 80386-SX 16 MHz microprocessor. Externally this uses a 16-bit bus similar to the 286 AT compatible machines, however, internally the 386-SX microprocessor is compatible with that of a 80386 processor.

The Compact 386-SX features 512 K onboard RAM, optionally expandable onboard to 1 MB, 2 MB or 4 MB and up to 16 MB with expansion boards. Other features: Processor speed 16 MHz (switchable to 8 MHz), 8 expansion slots, Heavy Duty Power Supply, Two Serial Ports, one Parallel Port, Real Time Clock, one 1.2 MB floppy disk drive (optionally available with 5.25" 360K, 720K 3.5" or 1.44 MB floppy disk drive), Enhanced 101-key keyboard. Features a small footprint, yet it can take as many cards and drives (including hard drives) as full-sized models.

Example: a fully loaded system can feature two 5.25" drives, a 3.5" floppy drive, one half-height 5.25" hard drive and one 3.5" hard drive. With a single 5.25" disk drive, you have room for a full height hard drive (such as 300+ MB) and still have room for 3.5" floppy and a second 3.5" hard drive. All this as well as a total of 8 expansion cards!

BASIC SYSTEM FEATURES

- 80386SX 16MHz processor
- 512 K RAM (optionally expandable to 4 MB)
- Page mode interleaved memory architecture
- LIM 4.0 support for memory over 1 MB
- 1.2 MB 5.25" or 3.5" 720K floppy drive
- Floppy Controller & Hard Drive Controller
- Socketed for 80387SX math coprocessor
- 2 Serial Ports
- Parallel Port, Real Time Clock/Calendar
- 8 expansion slots
- Enhanced 101-key keyboard
- Keylock and Status Display
- Heavy Duty Power Supply
- Phoenix BIOS
- CSA Approved
- Made in Canada - including motherboard

BASIC SYSTEM

$1995

C-386SX

COMPACT 386-SX CONFIGURATIONS

Basic system complete with hard drive and video card selection. Price does not include monitor.

DRIVE	MONO	EGA	VGA	VGA PLUS
20 MB (65mS)	$2430 *C-386SX20M*	$2645 *C-386SX20E*	$2695 *C-386SX20*	$2895 *VC-386SX20VP*
40 MB (39mS)	$2630 *C-386SX40SM*	$2845 *C-386SX40SE*	$2895 *C-386SX40SV*	$3095 *C-386SX40SVP*
40 MB (28mS)	$2875 *C-386SX40FM*	$3090 *C-386SX40FE*	$3140 *C-386SX40FV*	$3340 *C-386SX40FVP*
70 MB (22mS)	$3175 *C-386SX70M*	$3390 *C-386SX70E*	$3440 *C-386SX70V*	$3640 *C-386SX70VP*
100 MB (22mS)	$3575 *C-386SX100M*	$3790 *C-386SX100E*	$3840 *C-386SX100V*	$4040 *C-386SX100VP*
320 MB (18mS)	$5030 *C-386SX320M*	$5245 *C-386SX320E*	$5295 *C-386SX320V*	$5495 *C-386SX320VP*

Please note: VGA Adaptor Cards are 8-bit, VGA Plus Cards are 16-Bit.

EXTRA FLOPPY DRIVES

5.25" 360K	$125	*JU455*
5.25" 1.2 MB	$155	*JU475*
3.5" 720K	$125	*JU253*
3.5" 1.44 MB	$155	*JU257*

OPTIONAL MEMORY CONFIGURATIONS *

Extra 512K (using 256K SIMMs, Total 1 MB)	$299	*C-386SX-1MB*
2 MB (using 1MB SIMMs, Total of 2 MB)	$799	*C-386SX-2MB*
4 MB (using 1MB SIMMs, Total of 4 MB)	$1699	*C-386SX-4MB*

* (Prices are additional to system price)

PERIPHERALS

60 MB Tape Drive Backup	$995	*ST600I*
80387SX Math Coprocessor	$599	*80387SX-16*
1200 Baud Internal Modem	$149	*1200I*
2400 Baud Internal Modem	$299	*2400I*
BEST network card (Novell compatible)	$279	*B9026*

BEST COMPACT 386 FAMILY

BEST COMPACT 386 (8-slot 386 System)

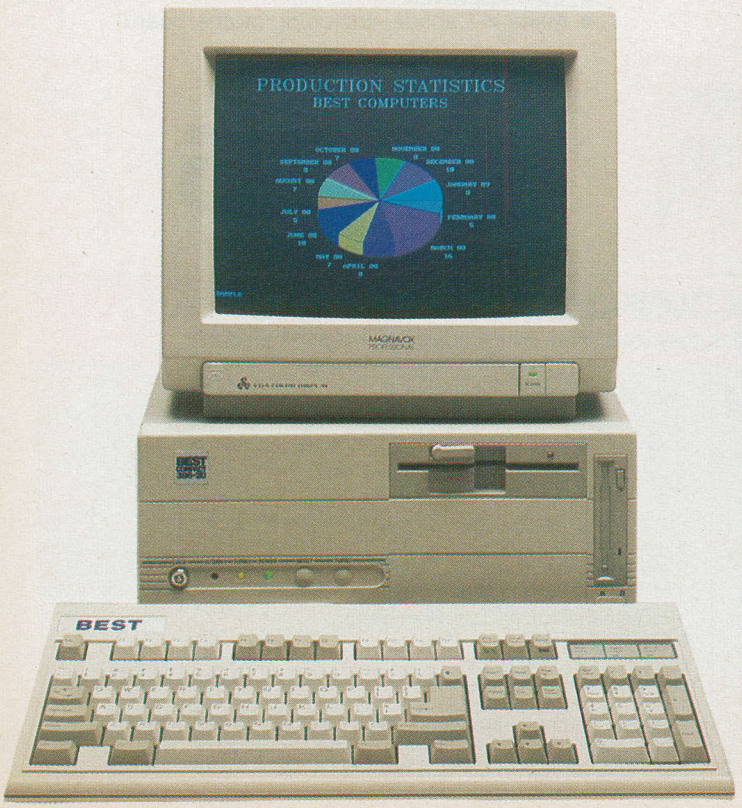
Based on the Intel 80386 microprocessor, Phoenix BIOS, One 1.2MB Floppy Diskette Drive (Optional 360K 5.25" Floppy Drive or 720K 3.5" Floppy Drive or 1.44MB 3.5" Floppy Drive), socketed for 80387 math co-processor, 8 Expansion Slots, Two Serial Ports, One Parallel Port, Real Time Clock, Floppy Controller, Enhanced 101- key Keyboard, available with 32-bit memory in the following RAM configurations: 1 MB, 2 MB, 4MB, 8 MB, 16 MB. Features a small footprint, yet it can take as many cards and drives (including hard drives) as full-sized models. Example: a fully loaded system can feature two 5.25" drives, 3.5" floppy drive, one half-height 5.25" hard drive and one 3.5" hard drive. With a single 5.25" disk drive, you have room for a full height hard drive (such as 300+ MB) plus still have room for 3.5" floppy and a second 3.5" hard drive. All this as well as a total of 8 expansion cards!

BASIC SYSTEM FEATURES

- 80386 processor,
- 2 MB of 32-bit RAM (optionally expandable to 16 MB)
- 1.2 MB 5.25" or 3.5" 720K floppy drive
- Dual Floppy Drive Controller
- Hard Drive controller
- Socketed for 80387 math coprocessor
- 2 Serial Ports
- Parallel Port, Real Time Clock/Calendar
- 8 expansion slots
- Enhanced 101-key keyboard
- Phoenix BIOS
- Keylock and Status Display
- CSA Approved
- Heavy Duty Power Supply
- Made in Canada - including motherboard

BEST 386 TOWER SYSTEMS

The above 20 and 25 MHz systems are also available in our attractive, space-saving Tower case. This offers excellent flexibility for almost any combination of disk, hard and tape drives, along with a 230W power supply. **The BEST 386 Tower System is shown on the cover of this catalogue.**



BASIC PRICES

SYSTEM	PRICE	CODE
BEST Compact 386-16 (16MHz)	$3195	C-386-16
BEST Compact 386-20 (20MHz)	$3495	C-386-20
BEST Compact 386-25 (25MHz) (386-25 has cache memory)	$6995	C-386-25

BEST COMPACT 386-16 (16MHz operation)

Basic system complete with hard drive and video card selection. Price does not include monitor.

Drive	Mono	EGA	VGA	VGA Plus
40 MB (39mS)	$3830 C-386-1640SM	$4045 C-386-1640SE	$4095 C-386-1640SV	$4295 C-386-1640SVP
40 MB (28mS)	$4075 C-386-1640FM	$4290 C-386-1640FE	$4340 C-386-1640FV	$4540 C-386-1640FVP
70 MB (22mS)	$4375 C-386-1670M	$4590 C-386-1670E	$4640 C-386-1670V	$4840 C-386-1670VP
100 MB (22mS)	$4775 C-386-16100M	$4990 C-386-16100E	$5040 C-386-16100V	$5240 C-386-16100VP
320 MB (18mS)	$6230 C-386-16320M	$6445 C-386-16320E	$6495 C-386-16320V	$6695 C-386-16100VP

BEST COMPACT 386-20 (20MHz operation)

Drive	Mono	EGA	VGA	VGA Plus
40 MB (39mS)	$4130 C-386-2040SM	$4345 C-386-2040SE	$4395 C-386-2040SV	$4595 C-386-2040SVP
40 MB (28mS)	$4375 C-386-2040FM	$4590 C-386-2040FE	$4640 C-386-2040FV	$4840 C-386-2040FVP
70 MB (22mS)	$4675 C-386-2070M	$4890 C-386-2070E	$4940 C-386-2070V	$5140 C-386-2070VP
100 MB (22mS)	$5075 C-386-20100M	$5290 C-386-20100E	$5340 C-386-20100V	$5540 C-386-20100VP
320 MB (18mS)	$6530 C-386-20320M	$6745 C-386-20320E	$6795 C-386-20320V	$6995 C-386-20100VP

BEST COMPACT 386-25 (25 MHz operation)

(25 MHz version has cache memory)
(Please note: VGA Adaptor Cards are 8-bit, VGA Plus Cards are 16-Bit)

Drive	Mono	EGA	VGA	VGA Plus
40 MB (39mS)	$7630 C-386-2540SM	$7845 C-386-2540SE	$7895 C-386-2540SV	$8095 C-386-2540SVP
40 MB (28mS)	$7875 C-386-2540FM	$8090 C-386-2540FE	$8140 C-386-2540FV	$8340 C-386-2540FVP
70 MB (22mS)	$8175 C-386-2570M	$8390 C-386-2570E	$8440 C-386-2570V	$8640 C-386-2570VP
100 MB (22mS)	$8575 C-386-25100M	$8790 C-386-25100E	$8840 C-386-25100V	$9040 C-386-25100VP
320 MB (18mS)	$10030 C-386-25320M	$10245 C-386-25320E	$10295 C-386-25320V	$10495 C-386-25100VP

OPTIONAL MEMORY CONFIGURATIONS *

(Prices are additional to system price)

4 MB (using 1MB chips, Total of 4 MB)	$995	C-386-4MB-RAM
8 MB (using 1MB chips, Total of 8 MB)	$2985	C-386-8MB-RAM
16 MB (using 1MB chips, Total of 16 MB)	$6965	C-386-16MB-RAM

EXTRA FLOPPY DRIVES

5.25" 360K	$125	JU455
5.25" 1.2 MB	$155	JU475
3.5" 720K	$125	JU253
3.5" 1.44 MB	$155	JU257

PERIPHERALS

60 MB Tape Drive Backup	$995	ST600I
80387-16 MHz Math Coprocessor	$639	80387-16
80387-20 MHz Math Coprocessor	$749	80387-20
80387-25 MHz Math Coprocessor	$949	80387-25
1200 Baud Internal Modem	$149	1200I
2400 Baud Internal Modem	$299	2400I
BEST network card (Novell compatible)	$279	B9026
DOS 4.01 (or latest version)	$119	MSDOS

TOWER SYSTEMS

Extra Price of Tower Case (additional to system price)...**$295**
Please specify TOWER System when ordering.

BEST COMPACT 286 FAMILY

BEST COMPACT 286 (8-slot 286 System)

Based on the Intel 80286 microprocessor, Phoenix BIOS, One 1.2MB Floppy Diskette Drive (Optional 360K 5.25" Floppy Drive or 720K 3.5" Floppy Drive or 1.44MB 3.5" Floppy Drive), socketed for 80287 math co-processor, 8 Expansion Slots, Two Serial Ports, One Parallel Port, Real Time Clock, Floppy Controller, Enhanced 101-key Keyboard, Heavy Duty Power Supply, Keyboard Lock, Status Display. Available with 16-bit memory in the following RAM configurations: 640K or 1 MB on board and optionally to 16 MB using expansion cards.

BASIC SYSTEM FEATURES

- 80286 processor,
- 640 K of 16-bit RAM (optionally expandable to 16 MB)
- 1.2 MB 5.25" floppy drive
- Dual Disk Drive controller
- Socketed for 80287 math coprocessor
- 2 Serial Ports
- Parallel Port, Real Time Clock/Calendar
- 8 expansion slots
- Enhanced 101-key keyboard
- Phoenix BIOS
- Keylock and Status Display
- CSA Approved
- Heavy Duty Power Supply
- Made in Canada - including motherboard

BASIC PRICE

SYSTEM	PRICE	CODE
BEST Compact 286-10 (10MHz)	$995	C-286-10
BEST Compact 286-12 (12MHz)	$1295	C-286-12
BEST Compact 286-16 (16MHz)	$1995	C-286-16

BEST COMPACT 286

Basic 10MHz system complete with hard drive (including controller) and video card selection. Price does not include monitor.
For 12Mhz and 16MHz basic systems, see additional charge below.

Hard Drive	Mono	EGA	VGA	VGA Plus
20 MB (65mS)	$1510 *C-286-10-20M*	$1725 *C-286-10-20E*	$1775 *C-286-10-20V*	$1975 *C-286-10-20VP*
40 MB (39mS)	$1710 *C-286-10-40SM*	$1925 *C-286-10-40SE*	$1975 *C-286-10-40SV*	$2175 *C-286-10-40SVP*
40 MB (28mS)	$1955 *C-286-10-40FM*	$2170 *C-286-10-40FE*	$2220 *C-286-10-40FV*	$2420 *C-286-10-40FVP*
70 MB (22mS)	$2255 *C-286-10-70M*	$2470 *C-286-10-70E*	$2520 *C-286-10-70V*	$2720 *C-286-10-70VP*
100 MB (18mS)	$2655 *C-286-10-100M*	$2870 *C-286-10-100E*	$2920 *C-286-10-100V*	$3120 *C-286-10-100VP*
320 MB (18mS)	$4110 *C-286-10-320M*	$4325 *C-286-10-320E*	$4375 *C-286-10-320V*	$4575 *C-286-10- 320VP*

(Please note: VGA Adaptor Cards are 8-bit, VGA Plus Cards are 16-Bit)
Hard drive controller included.

EXTRA FLOPPY DRIVES

5.25" 360K	$125	*JU455*
5.25" 1.2 MB	$155	*JU475*
3.5" 720K	$125	*JU253*
3.5" 1.44 MB	$155	*JU257*

For 286-12 (12MHz) versions add $300 to prices above
For 286-16 (16MHz) versions add $1000 to prices above

Please note: order codes also change for 12 and 16MHz versions, replace the section of the order 10 with 12 or 16 as applicable. For example C-286-10-20E becomes C-286-12-20E.

OPTIONAL MEMORY CONFIGURATIONS *

* (Prices are additional to system price)

Extra 384 K (using 256K chips, Total of 1 MB)	$299	*C-286-384K-RAM*

PERIPHERALS

60 MB Tape Drive Backup	$995	*ST600I*
80287-10 Math Coprocessor	$438	*80287-10*
1200 Baud Internal Modem	$149	*1200I*
2400 Baud Internal Modem	$299	*2400I*
BEST network card (Novell compatible)	$279	*B9026*
Intel Above Board II Plus - 512 K	$695	*ABV-BRD 512K*
AST Rampage Plus-286 - 512 K	$995	*AST-RMPG-512K*
DOS 4.01 (or latest version)	$119	*MSDOS*

BEST PERFORMER 286 FAMILY

"Sleek and powerful..."

(10, 12 or 16 MHz, 3-slot AT Compatible)

Based on the Intel 80286 microprocessor, Phoenix BIOS, One 5.25" 1.2MB Floppy Diskette Drive (optionally up to two 3.5" 720K or 1.44 MB Floppy Drives in place of 5.25" drive), room for slim-line Hard Drive (20, 40 or 100 MB) inside case. Virtually everything's on the motherboard!....the BEST Performer features the latest technology motherboard which incorporates the following: 640K RAM (optionally expandable to 1 MB onboard and higher using 16-Bit memory expansion cards) socketed for 80287 math co-processor, Dual Floppy Controller and AT Conner Hard Drive Controller, two Serial Ports, one Parallel Port, Real Time Clock, with TTL monochrome video piggy-back board (optionally upgradable to EGA). All this and you STILL have 3 full-size slots free (two 16-bit, one 8-bit). Enhanced 101-key Keyboard, case and keyboard lock, status indicator, power supply with front panel on-off switch and packaged in a sleek, low-profile, attractive case.

Although the BEST Performer makes an excellent stand-alone system, it is exceptional in a network environment as a workstation.

BASIC PRICE

SYSTEM	PRICE	CODE
BEST Performer 286-10 (10MHz)	$1295	CP-286-10
BEST Performer 286-12 (12MHz)	$1725	CP-286-12
BEST Performer 286-16 (16MHz)	$1995	CP-286-16

BEST PERFORMER 286

Basic 10MHz Performer System complete with hard drive and video card selection. Price does not include monitor.
For 12 or 16 MHz versions, see additional charge below.

Drive	Mono	EGA	VGA	VGA Plus
40 MB (28mS)	$2175 *CP-286-1040FM*	$2390 *CP-286-1040FM*	$2440 *CP-286-1040FM*	$2640 *CP-286-1040FM*
100 MB (18mS)	$2875 *CP-286-10100M*	$3090 *CP-286-10100M*	$3140 *CP-286-10100M*	$3340 *CP-286-10100M*

(Please note: VGA Adaptor Cards are 8-bit, VGA Plus Cards are 16-Bit)

For Performer 286-12 (12MHz) versions add $430 to prices above.
For Performer 286-16 (16MHz) versions add $700 to prices above.

Please note: order codes also change for 12 and 16MHz versions, replace the section of the order 10 with 12 or 16 as applicable. For example: CP-286-1020E becomes C-286-1220E.

EXTRA FLOPPY DRIVES

Optional Floppy Drives and bezel (in place of the 5.25" drive).

3.5" 720K	$125	*JU253 3.5"*
1.44 MB	$155	*JU257*

OPTIONAL MEMORY CONFIGURATIONS

(Prices are additional to system price)

Extra 384 K (using 256K chips, Total of 1 MB)	$299	*CP-286-384K-RAM*

PERIPHERALS

80287 -10 MHz Math Coprocessor	$438	*80287-10*
80287 -12 MHz Math Coprocessor	$569	*80287-12*
1200 Baud Internal Modem	$149	*1200I*
2400 Baud Internal Modem	$299	*2400I*
BEST network card (Novell compatible)	$279	*B9026*
DOS 4.01 (or latest version)	$119	*MSDOS*

BASIC SYSTEM FEATURES

- Basic System
- 80286 processor,
- 640 K of 16-bit RAM (optionally expandable to 16 MB)
- 1.2 MB 5.25" floppy drive
- Dual Disk Drive controller
- AT Conner Hard Drive controller
- Socketed for 80287 math coprocessor
- Two Serial Ports
- Parallel Port, Real Time Clock/Calendar
- Three expansion slots (two 16-bit, one 8-bit)
- Enhanced 101-key keyboard
- Phoenix BIOS
- Keyboard and case lock and Status Display
- CSA Approved
- Made in Canada - including motherboard

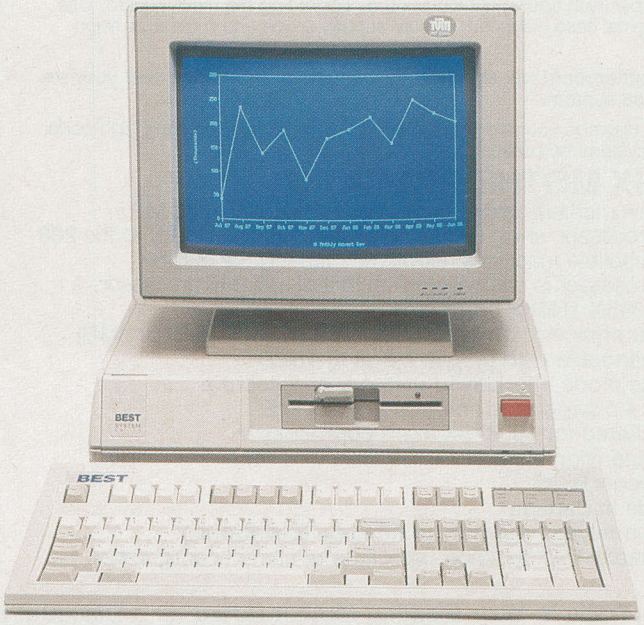
BEST PERFORMER 8086 10-3

(10 MHz, 3-slot XT Compatible)

Based on the Intel 8086 10MHz microprocessor, Phoenix BIOS, One 5.25" 360K Floppy Diskette Drive (Optionally up to two 3.5" 720K or 1.44 MB Floppy Drives in place of 5.25" drive), room for slim- line Hard Drive (20, 40 or 100 MB) inside case. The BEST Performer features the latest technology motherboard which incorporates the following: 640K RAM, socketed for 8087 math co-processor, Dual Floppy Controller and SCSI Hard Drive Controller, two Serial Ports, one Parallel Port, Real Time Clock, with TTL monochrome video piggy-back board. All this - and you STILL have 3 full-size slots free. Enhanced 101-key Keyboard, case and keyboard lock, status indicator, power supply with front panel on-off switch and packaged in a sleek, low-profile, attractive case. Although the BEST Performer makes an excellent stand-alone system, it is excellent in a network environment as a workstation.

FEATURES

- 8086 processor,
- 640 K
- 720 K 3.5" or 360 K 5.25" floppy drive
- Dual Disk Drive controller
- SCSI Hard Drive controller
- Socketed for 8087 math coprocessor
- 2 Serial Ports
- Parallel Port, Real Time Clock/Calendar
- 3 expansion slots
- TTL video adaptor
- Enhanced 101-key keyboard
- Phoenix BIOS
- Keyboard and case lock and Status Display
- CSA Approved
- Made in Canada - including motherboard



BASIC SYSTEM

$795

CP-8086-10-3

OUR BEST SPECIALS

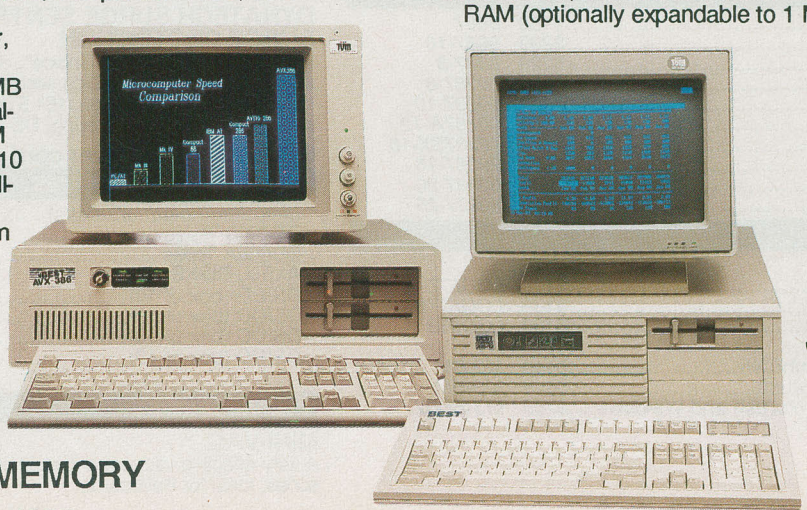
Most of this catalogue describes our new range of computers. However, we still have a number of systems which, while offering spectacular performance, are housed in previous model cases or perform at slower speeds than our latest models.

These are all brand new and carry our full one year warranty. Check these prices - they're probably the lowest you'll ever see and the stock will not last at these prices.

BEST AVX 386-16

(16 MHz, 8-slot 386 System)

Based on the Intel 80386 32-bit microprocessor, Phoenix BIOS, One 1.2MB Floppy Diskette Drive (Optional 360K 5.25" Floppy Drive or 720K 3.5" Floppy Drive or 1.44MB 3.5" Floppy Drive), Socketed for 80387 math co-processor, 8 Expansion Slots, Two Serial Ports and One Parallel Port, Real Time Clock, Floppy Controller, 200W+ Power Supply, 101 Enhanced Keyboard. Comes with 1 MB of 32-bit onboard memory. Optionally expandable to the following RAM configurations: 2 Mb, 4MB, 8 MB, 10 MB, 16 MB (all 32-bit). Features full-size AT style case with status display panel, keyboard lock and room inside for a full height 5.25" hard drive. The back panel has extra slots for peripheral connections.



$1995

WITH 1 MB OF 32-BIT MEMORY

COMPACT 286-10

(10 MHz, 8-slot AT Compatible)

Motherboard uses the latest technology LSI G/2 three chip solution providing ultra-high reliability. One 1.2 MB disk drive (but easily add other 5.25", 3.5" floppy or hard drives), Phoenix BIOS, Socketed for 80287 math co-processor, 640K RAM (optionally expandable to 1 MB onboard and higher using 16-Bit memory expansion cards), 8 Expansion Slots, Two Serial Ports and One Parallel Port, Real Time Clock, Floppy Controller, 101 Enhanced Keyboard, power supply and keylock included.

$995

ORIGINALLY SOLD AT $1995

386 & 386SX UPGRADE BOARDS

You can now get 386 performance and compatibility from your IBM AT or compatible (with equivalent footprint) by upgrading the motherboard. Use your original case, keyboard, power supply, drives and most expansion boards.

This motherboard will significantly increase performance over your existing 286 system.

We can upgrade your existing system for you with the following high performance system motherboards:

386SX MOTHERBOARD

This new motherboard features the Intel 80386SX 16 MHz microprocessor which uses a 16 bit external bus similar to the 286 AT compatible machines. However internally the 386-SX microprocessor is compatible with that of a 80386 processor.

- **80386SX 16MHz processor**
- **Your choice of on-board RAM (512K, 1MB, 2MB or 4MB)**
- **Expandable with plug-in cards to 16MB**
- **Page mode interleaved memory architecture**
- **LIM 4.0 support for memory over 1 MB**
- **Socketed for 80387SX math coprocessor**
- **8 expansion slots**
- **Phoenix BIOS**
- **Made in Canada**
- **Full one year warranty (if fitted by Exceltronix)**

Call, write or FAX for price - specify your current configuration.

386 20MHZ UPGRADE

This superb, latest integrated technology motherboard features the following:

- **80386 processor,**
- **1 MB of 32-bit RAM (optionally expandable on-board to 2, 4, 8, 10 or 16 MB of 32-bit memory)**
- **Socketed for 80387 math coprocessor**
- **Real time clock/calendar with built-in battery backup**
- **8 expansion slots**
- **Phoenix BIOS**
- **Made in Canada**

386 25MHZ UPGRADE

This 25MHz with cache memory features the following:

- **80386 processor**
- **1 MB of 32-bit RAM (optionally expandable on-board to 2, 4, 8, 10 or 16 MB of 32-bit memory)**
- **Socketed for 80387 math coprocessor**
- **Real time clock/calendar with built-in battery backup**
- **Two serial Ports, one parallel port**
- **8 expansion slots**
- **Memory caching, making the system blindingly fast!**
- **Phoenix BIOS**
- **Made in Canada**

Trade In Your Existing Mother-Board for a Discount on Our Upgrade Boards. (Most boards acceptable)

JOYSTICKS AND GAME CARDS

CH PRODUCTS

GAMECARD III + (for 1 joystick)	$45	*CH III G*
GAMECARD III + with Y cable for 2 joysticks	$59	*CH III-GY*
MACH II JOYSTICK	$39	*CH II-J*
MACH III JOYSTICK (extra fire button)	$48	*CH III-J*
THE FLIGHTSTICK	$79	*CH-Flight*

MEMORY EXPANSION CARDS

Intel Above Board Plus - 512K, exp. to 8Mb	$695	*AB+512K*
Piggyback board WITH 2MEG for Above Board Plus	$2095	*AB+PIG*
AST Rampage +286 512K expandable to 8M	$995	*AST512*

FAX CARDS

JT FAX CARDS — **$499** *JT-FAX*

Internal half size card. Group III compatible facsimilie machine. 4800 bps. Chip Set. Menu driven software includes phone directory, transaction log, scheduling system and broadcast feature. One step convert and send, automatic print on receive display, allows zoom, reduce and flip Includes Dual RJIIC phone connector.

JT-FAX PORTABLE — **$675** *JTFP*

Pocket size portable fax. For MS DOS compatible laptops. Group III. Also includes carry case and 9-25 pin converter cable.

MATH CO - PROCESSORS

8087 (5MHz)	$159	*8087*
8087-1 (10MHZ)	$299	*8087-10*
8087-2 (8 MHZ)	$229	*8087-8*
80287-8 (8MHZ)	$369	*80287-8*
80287-10 (10MHZ)	$438	*80287-10*
80287A-12 (12MHZ)	$569	*80287A-12*
80387SX-16 (16MHZ)	$599	*80387SX-16*
80387-16 (16MHZ)	$639	*80387-16*
80387-20 (20MHZ)	$749	*80387-20*
80387-25 (25MHZ)	$949	*80387-25*

MICE

LOGITECH		
Serial Mouse C7	$109	*LOGIC7s*
Bus Mouse	$109.	*LOGIC7B*
Hi Rez Mouse (Bus)	$139	*LOGIHB*
MICROSOFT		
Serial Mouse with Paintbrush	$149	*MS-SM*
Bus Mouse with Paintbrush	$149	*MS-BM*
Serial or BUS with Paintbrush and Windows	$185	*MS-BMW*

PORTABLE COMPUTERS

BONDWELL B210 — **$1,995** *BD210*

80C88 - 8 MHz microprocessor, 8087 socket, 1 MEG RAM, Supertwist LCD screen, Two 720K Floppy Drives, 95-key keyboard, 10 function keys, includes RTC , Built-in rechargeable battery, 1200 bps Hayes compatible modem, serial/parallel port, includes MSDOS and EASY word processor, FREE CARRYING CASE

BONDWELL 8T — **$2,895** *BD8T*

Same as above except: 20 meg Hard drive, 1 720K Floppy drive

BONDWELL B300 — **$3,895** *BDB300*

80286 (10 MHz) Microprocessor, 1 Meg memory (expandable to 1.5 MB), 10.5" supertwist LCD, Backlight Switch, 20 MB HD with separate ON/OFF switch, 1.44 Meg 3.5" floppy, 94-Key keyboard, 10 function keys, RTC, 1200 Baud Hayes Compatible Modem, Serial/parallel port, Rechargeable battery, includes MSDOS and EASY Word Processing Software

POWER BARS

P15 POWER DIRECTOR
Surge and spike protector — **$195** *P15*

5 Outlets, Ergonomic design, comes with a 5 1/4" diskette, storage pocket, includes modem protection.

6 OUTLET POWER BAR — **$25** *PB-6*

POWER PROTECTION

DYNATECH SURGE SENTRY
SURGE PROTECTION — **$89** *D-SS-SP*

PC Magazine's "Editors Choice", SPN's "Product of the Year". Patented 3 stage circuitry for fast 5 pica second response time, a gas discharge tube for high energy dissipation (181.5 Joules), UL and CSA listing, 10 Year Warranty, RFI/EMI Noise Filtering, DS-2, 2 outlet, plugs directly into the wall

6 outlet, 6' AC power cord — **$139** *DS-6*

DISKETTES AND SUPPLIES

Disk Box (holds 120 disks)	$10.00	*Dsk-Box-120*
DC2000 Tapes	$49.00	*DC2000*
DC600A Tapes	$59.00	*DC600A*
MAXELL DISKS		
DS/DD (box of 10)	$12.95	*MD2-D*
DS/DD (box of 10)	$22.95	*MD2-HD*
DS/DD (box of 10)	$27.95	*MF2-DD*
DS/HD (box of 10)	$64.95	*MF2-HD*

CLEANING AIDS

MINI-VAC — **$19.98** *MINIVAC*

A very effective vacuum and dust off blower with a full compliment of accessories. Ideal for Keyboards.

MONITORS

PHILIPS 7BM 623 **$125** *7BM623*
12" Monochrome TTL input monitor, long persistance amber phosphor, non-glare treated faceplate, two year warranty, FREE tilt and swivel stand

PHILIPS CM 8762 **$399** *CM8762*
13" RGB/composite inputs (CGA), 640 X 240 resolution, Green display switch, Built in tilt stand, One year warranty

PHILIPS 9CM053 **$595** *9CM053*
14" EGA Monitor, Glare - reducing etched glass tube face, 64 colour capability in EGA mode, up to 640 X 350 resolution in EGA mode, green and amber text switch, 0.39 mm. dot pitch, two year warranty

PHILIPS 7BM 749 **$250** *7BM749*
14" Flat screen VGA white monitor, analog input allows 64 shades of grey to be displayed, CRT has anti-glare dark faceplate, tilt and swivel base included, 31.5 KHz horizontal scan rate, 50 to 70 Hz vertical refresh rate, up to 640 X 480 resolution supported.

PHILIPS 9CM082 **$725** *9CM082*
14" VGA colour CRT, Maximum resolution of 800 X 600, Analog input for a virtually infinite number of colours to be displayed, Anti-glare etched faceplate, 31.5 KHz horizontal scan rate, 0.31 dot pitch, tilt swivel base inc.

TVM MD 300 **$525** *MD300*
14" CGA Monitor, 640 X 200 resolution, select between green, amber, white on blue or full colour text, 0.39 mm dot pitch, non-glare screen

TVM MD 700 **$750** *MD700*
14" EGA monitor, dark tint, non glare screen, 0.31 mm dot pitch, 640 X 350 resolution, amber, green, white on blue or full colour text

TVM MG 11 **$369** *MG11*
14" VGA white monitor, dark tint, non glare screen, 0.31 mm dot pitch, 640K X 480 resolution, amber, green, white or blue or full colour text

TVM MG 12-H **$750** *MG12 - H*
14" Colour VGA monitor, dark tint, non glare, 0.31 mm dot pitch, resolution of 640 X 480 (graphics) & 720 X 400 (text), full colour with a switch for green, amber white or blue.

NEC Multisync monitors; automatically scan all frequencies between 15.75 KHz and 35 KHz. This makes these monitors compatible with all colour graphics boards that work with the IBM-PC.

NEC MULTISYNC II **$995** *NEC-II*
14" diagonal screen, 800 X 560 resolution

NEC MULTISYNC 2A **$975** *NEC-2A*
Specifically designed for VGA and Super VGA users, Able to display 640 X 480 and 800 X 600 resolution, Auto sync between VGA and Super VGA resolution

NEC MULTISYNC 3D **$1,275** *NEC 3D*
Supports 1024 X 768, IBM 8514 A compatible, Fully downwards compatible

NEC MULTISYNC GS **$425** *NEC GS*
Available in white, green or amber, 14" non glare flat square corner CRT , Well-defined grey scale imagings in up to 64 shades, 720 X 480 resolution

SAMSUNG SM 430A **$195** *SM430A*
Amber monitor, 14" monochrome TTL input monitor

SAMSUNG SM430G **$195** *SM430G*
Green monitor 14" , monochrome TTL input monitor

SAMSUNG SM430W **$195** *SM430W*
White monitor, 14" monochrome TTL input monitor, high contrast, non glare flat screen , tilt and swivel base

SAMSUNG SM 200A **$135** *SM200A*
12" monochrome TTL input monitor amber.

NETWORKING

NOVELL

Exceltronix is a Novell authorized dealer. Advanced netware allows personal computers to link together in order to share resources. Advance netware supports over 35 different types of network hardware.

Novell Advanced Netware 286 (dedicated server) $3,495.00 NADV
Entry level solution (ELS) - entry level, does not require dedicated file server, not expandable beyond 4 users.

4 users	$795.00	*ELS I*
8 users	$1,595.00	*ELS II*
Active Hubs - 8 port - boosts signal	$495.00	*ACT-8*
Passive Hubs - 4 port	$69.00	*PAS-4*

NETWORK CARDS

Arcnet - Best 9026 Arcnet	$279.00	*B9026*
Pure Data- PDI Arcnet - 16 bit	$550.00	*PDI-16*
Ethernet- Western Digital	$399.00	*WDLANERPR*
Ethercard with Boot Rom Socket	$475.00	*WDBOOT*
Autoboot Rom for Novell	$ 50.00	*WDROM*

VIDEO BOARDS

SUPER VGA

ATI VGA Wonder **$550 (with 512K $795)** *ATIIVGAW*
1024 X 768 VGA resolution or multifrequency monitors, automatic monitor detect, downwards compatible, autobus detect for 8 or 16 bit slots, runs on 16 bit data path with 1:1 interleave, FREE Mouse on board, 256 K standard memory.

VIDEO 7 VEGA VIDEO CARD **$489** *VEGAVGA*
800 X 600 in 16 colours from a palette of 64 with multi frequency monitors, with analog monitors, the VEGA supports resolutions of 640 X 480 in 16 colours from a palette of 262,144 colours, High res drivers for Windows/386, Windows, Autocad, Autoshade and Lotus 1-2-3, and a 132 column by 43 lines format for 1-2-3-, Symphony, Word Perfect, and Wordstar included.

Western Digital VGA + **$575** *WDVGA +*
100% compatible with IBM's new PS/2 VGA graphics, up to 100% faster than IBM VGA card, enhanced resolution, 132 column text, 800 X 600 in 16 colours of 256K palett, 100% downward compatibility EGA, CGA, MDA, HERCULES, & MCGA, for use with 80286 & 80386 models, 3 year manufacturer warranty.

VGA PROFESSIONAL **$845** *WDVGAP*
16 bit bus, 100% compatible with IBM's VGA , 256 colours from 256K palette, 640 X 480 reso lution 256 colours, operates up to 400% faster than IBM, 800 X 600 in 16 colours, 132 column, 3 year manufacturer warranty .

VGA

Hercules VGA **$349** *HERCVGA*
VGA 640 X 480 with 16 colours or 320 X 200 in 256 colours, easy to use, no switches or jumpers to set

STB VGA - Multi RES II **$349** *STB VGA*
VGA - 640 X 480, Downward compatible to EGA, CGA and MGA

EGA

STB EGA, **$295** *STB EGA*
Auto EGA, software switchable between 16 modes, 640 X 350 in 16 colours on EGA or Multi frequency monitors

EXCELTRONIX EGA **$250** *EX-EGA*
640 X 350 resolution in 16 colours on EGA or multi-frequency monitors, software switchable modes

ATI EGA Wonder 800 **$399** *ATI-EGA-W*
can now display VGA graphics standard on multi-frequency monitor. It displays 800 X 560, 752 X 410 and 640 X 480 high resolution text and graphics on multi frequency monitor. This allows WYS 1W 16 display for desktop publishing software packages.

HERCULES/CGA

DUAL MODE GENERIC **$85** *DMG*
manual switching between CGA and monochrome graphics, best suited for either monochrome only or colour only environment. This card will support 720 X 348 in monochrome mode, 640 X 200 in 4 colours in colour mode.

ATI Graphics Solution **$195** *ATI-GS*
offers great flexibility at a low price, autoswitching card, through software, which can be used with TTL, monochrome, RGB, composite colour or monochrome monitors. Hercules compatible with 720 X 348 pixel resolution in monochrome, IBM compatible colour graphics 640 X 200 in 16 colours, Runs colour graphics software on an IBM monochrome monitor, half sized card

DATA DISPLAY

Allows you to display your video information on an overhead projector. Ideal for training or group presentations. Simply place Data Display on any transmissive overhead projector, connect it to your computer's video port and turn it on.Display projects crisp, larger than life computer-generated images.Data display has built-in RGB and composite video ports. Presentation Partner Software to help you create dynamic presentations on IBM and compatibles highly efficient fan and air flow system and infrared head filtering shield, to guarantee consistent screen quality.

A-400 **$2,495** *DD-A-400*
For EGA (640 X 350 pixels), 16 shades of colour from a pallet of 64

A-200 **$1,995** *DD-A-200*
For CGA (640 X 200 pixels), 4 shades of colour from a pallet of 16

SOFTWARE

MSDOS 4.01 (or latest version)	$119.00	*MSDOS*
WordPerfect 5.0	$349.00	*WP*
Wordperfect (French)	$399.00	*WP-F*
LOTUS 1-2-3 (English)	$450.00	*1-2-3E*
Lotus 1-2-3 (French)	$450.00	*1-2-3F*
CROSSTALK MK IV	$185.00	*CROSS IV*
CROSSTALK X VI	$150.00	*CROSS XVI*

THE COLOUR OF MONEY.

SAMTRON'S NEW .31mm DOT PITCH EGA MONITOR SNOOKERS THE COMPETITION.

Price. Quality. Performance. For those who seek value for money in a colour monitor the SC 431-E is a leader in its class. With a 14'' display tube, .31mm dot pitch, direct drive input signal and automatic scanning frequency, this ergonomically designed EGA Monitor has a resolution second to none. In fact, the colour is so sharp it turns the competition another colour.

Call the professionals at Canara Technologies. They'll show you the Samtron Quality and help you pocket the savings.

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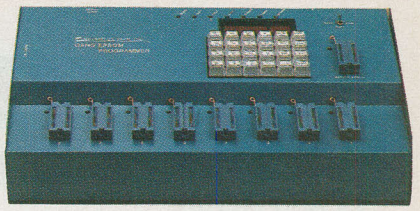
SAMTRON

EMPROM PROGRAMMER AND EMULATOR



Totally self-contained (has its own display, entry key-pad and power supply). Based on the Z-8 microprocessor. Can program up to 8 EPROMs simultaneously (anywhere from one to 8 EPROMs at the same time with the information in its own memory or master EPROM).

Each of the eight EPROM programming sockets is individually buffered and isolated from one another providing protection in situations when there is a bad EPROM among the eight being programmed, Clearly indicates and singles out any defective or marginal EPROMs prior to or after programming.

After programming the unit does a full VERIFY routine of the EPROM (at a Max Vcc of 5.4V and at a Min Vcc of 4.5V) to ensure high reliability of your EPROMs. Very simple to use.

A standard unit contains 8x16K of on-board memory which is sufficient in most cases, but can easily optionally be upgraded to 8x64K of on-board memory.

The Gang Programmer can handle a wide selection of EPROMs: 2716, 2732, 2732A, P2732A, 2532, 2564, 2764, 27128, 27128A and optionally upgradeable to handle 27256, 27256A, 27512, 27512A, 2758 and 2724. The programmer can also do a 16-bit Two's Complement Check-Sum of the data contained in the systems's RAM. Gives you the option of entering the data which you want to be programmed on the EPROM through a built-in keypad and display into the EPROM programmer's built-in RAM or by downloading the data to be programmed by RS232 interface (110 to 9600 Baud).

The RS232 is standard - not an option!

Data can be checked or modified since you can examine any memory location in the programmers built-in RAM, this holds true even after you have downloaded through the RS232 from your computer; you can check or modify the memory before finally programming it on your EPROMs.

Read Master EPROMs; you can plug in a programmed EPROM, dump it into the programmers RAM, check the contents on display by stepping through the memory and, if you wish, you can alter any location before copying to other EPROMs.

The EPROM Programmer can also be used as an EPROM emulator, saving hours of frustration, reprogramming and waiting. Using the emulator option, you can enter via the keyboard or download through the RS232 from your computer or development , the information which you think is right for whatever project you are building. This is the same information you would normally burn into an EPROM, plug into your undebugged processor and moments later you realize that you forgot to enter a code or that you must add or delete some codes. This would normally mean waiting 20 minutes for erasing of the EPROM and reprogramming and wasting time.

Using the EPROM emulator option, you simply plug in a 24 or 28 pin buffered pod into the socket on your board where you would normally fit the EPROM, the difference being now that you can have all the information in the programmers RAM, connected to the pod by a ribbon cable and you can start your testing. If you wish to change, add or delete any codes you can modify the contents of the programmers RAM using the keypad and display and continue testing moments later. Keep in mind that the RAM is protected from being accidentally altered.

Complete Package with EPROM Emulator, 8 ZIF sockets, Gang Programmer with 16K x 8 of RAM and RS232 $1495

Gang EPROM Programmer with 8 ZIF sockets, 16K x 8 RAM and RS232, without Emulator $995

HARD DRIVES

Seagate ST-225	20Mb	65ms	5 1/4" - 1/2 height, MFM	$350.00
Seagate ST-251	40Mb	39ms	5 1/4" - 1/2 height, MFM	$550.00
Miniscribe 3085	72Mb	22ms	5 1/4" - 1/2 height, MFM	$1,095.00
Miniscribe 8426	20Mb	65ms	3 1/2"-1/2 height, SCS1	$395.00
Miniscribe 8051S	40Mb	28ms	3 1/2"-1/2 height, SCS1	$795.00
Conner CP 340	40Mb	28ms	3 1/2'-1/2 Height., SCSI	$695.00
Conner CP 342	40Mb	28ms	3 1/2"-1/2 Height, IDE40	
Conner CP 344	40Mb	28ms	3 1/2"-1/2 Height, IDE40	$795.00
Conner CP 3104	100Mb	22ms	3 1/2"-1/2 Height, IDE40	$1,495.00
Seagate ST 225	20Mb	65ms	5 1/4"-1/2 Height, MFM	$350.00
Seagate ST125	20Mb	65ms	3 1/2"-1/2 Height, MFM	$425.00
Seagate ST 151	40Mb	28ms	3 1/2"-1/2 Height, MFM	$695.00
Seagate ST 251	40Mb	39ms	5 1/4"-1/2 Height, MFM	$550.00
Miniscribe 3650	40Meg	61ms	5 1/4"-1/2 Height, MFM	$475.00
(WHILE QUANTITIES LAST!!!)				
Miniscribe 8051A	40Mb	28ms	3 1/2"-1/2 Height, MFM	$850.00
Miniscribe 3053	40Mb	28ms	5 1/4"-1/2 Height, MFM	$695.00
(WHILE QUANTITIES LAST!!!)				
Miniscribe 3085	70Mb	28ms	5 1/4"-1/2 Height, MFM	$1,095.00
Micropolis 1335	72Meg	28ms	5 1/4" Full Height, MFM	$950.00
Micropolis 1355	145Meg	23ms	5 1/4" Full Height, ESDI	$1,795.00
Micropolis 1558	320Meg	18ms	5 1/4" Full Height, ESDI	$2,950.00
Priam ID60AT	60Mb	28ms	5 1/4"-1/2 Height, MFM	$895.00
Priam ID130AT	130Meg	28ms	5 1/4"-1/2 Height, MFM	$1,995.00
Maxstor XT1140	110Mb	27ms	5 1/4"-Full Height, MFM	$2,795.00
Maxstor XT 2190	160Mb	16ms	5 1/4"-Full Height, MFM	$2,795.00
Maxstor XT 4380	330Mb	16ms	5 1/4"-Full Height, ESDI	$3,995.00

PORTABLE EXTERNAL HARD DRIVES

HARDPAC

Portable, Rugged, Space efficient, Security, Convenient, Easy to use, Multiple applications.
HARDPAC 20 KIT includes 20 Meg hard disk drive (68ms average access). **$895.00**
HP20HOST HOST adaptor and cabling

HP-40 HARDPAC 40 KIT includes 40 Meg hard disk drive (28ms ave. access). **$998.00**
HP40HOST Host adaptor and cabling
Features common to both include: weight 2.2 lbs (1kg.), size 2" x 4.65" x 7.25", 7-5 mb/sec transfer rate, SCSI interface

HARD DRIVE CONTROLLERS

DRIVE CONTROLLER	PRICE	FLOPPY ONLY	XT	AT	MFM	SCSI	IDE 40	ESDI	HARD ONLY	HD/ FLOPPY
WD,XT-GEN	$75.		•		•				•	
1003-WAH	$175.			•	•				•	
1003-MM2	$175.			•	•					•
FOX-F001	$95.	•	•	•						
CONNER	$75.			•			•		•	
WD1007A WAH	$345.			•				•	•	
WD1007A WA2	$375			•				•		•
WD7000 FAST	$585.			•		•			•	

BACK-UP TAPE DRIVES

VP60E	Archive VP60E (60 Meg) External	$1,550.00
FT60E	Archive FT60 (60 Meg) External 5Mb/Minute Novell comp.	$995.00
ST600I	Archive ST600 (60Meg) Internal	$995.00
VP60I	Archive VP60I (60Meg) Internal, 6.75Mb/Min. Novell, 3com and Token ring compatible	$1,295.00
VP150E	Archive VP150E (150 Meg) External	$2,125.00
SC 499R	Host Adaptor (for FT and ST series)	$269.00
VP 402	Host Adaptor (for VP series)	$185.00

WANGTEK/LEGACY

LG 45/60 series

Up to 60 Meg, transfer rate up to 5Mb/Min., self aligning, self cleaning read/write heads.
INCLUDES SYTOS SOFTWARE
Features file by/file/image back up, restore and verification, time selected automatic back up, on line help and bad sector remapping. Runs with XT, AT, or 386 computer
Compatible with NOVELL, 3 COM, TOKEN RING, VINES, SCO XENIX V, and MS DOS.
Multi-level password security.

LG60E	LG 45/60 External	$1,589.00
PC36I	PC 36 Internal	$1,289.00

LEGACY x2 series

Supports 8086 to 80386/25 computers, PC/MS DOS, Novell, 3Com, Token Ring, Vines, Pick, Xenix and many more self-aligning read/write heads and ECC (error correction controls). 5 MB/min file by file or image backup

LG13660E	60 MEG EXTERNAL	$1,895.00
LG19000E	150 MEG EXTERNAL	$2,295.00
ADDITIONAL HOST ADAPTERS		
LG60HA	LEGACY 45/60 HOST ADAPTER	$349.00
LGX2HA	LEGACY X2 SERIES HOST ADAPTER	$389.00
TALLGRASS		
TG 1020I	20 MEG INTERNAL	$595.00
TG 1020E	20 MEG EXTERNAL	$959.00
TG 1040I	40 MEG INTERNAL	$849.00
TG 1040E	40 MEG EXTERNAL	$1,249.00
ADDITIONAL HOST ADAPTERS		
TG800I	TALLGRASS HOST ADAPTER FOR TG1020E	$229.00
TG900S	TALLGRASS HOST ADAPTER FOR TG1040E	$229.00

PRINTERS

ROLAND

ROLAND PR9101 — **$319** *PR9101*
192 cps, 6 fonts, 9 pitches, 2K buffer, 9 pin, NLQ & quiet mode Memo load switches from tractor to single sheet ,Perf Cut automatically advances paper for perforation tear-off then retracts it to top of form, pull and push pin feed. Two year warranty

ROLAND PR9104 — **$389** *PR9104*
240 cps, 6 fonts 9 pitches, 6K buffer, 9 pin, NLQ & quiet mode, Memo load switches from tractor to single sheet , Perf Cut automatically advances paper for perforation tear-off then retracts it to top of form, pull and push pin feed, two year warranty

ROLAND PR2417 — **$569** *PR2417*
240 cps, multi font capability from front panel controls, Same paper handling feature as PR9104, Push and pull type tractor feeds, Rear, Front and Bottom paper feed capabilities, Two year warranty.

BROTHER

DOT MATRIX

1724/3 — **$995** *BR1724/3*
216 cps. draft elite, 72 cps. Letter Quality, 24 pin head, Paper Parking, Automatic paper loading, Built-in rear feed forms tractor .

2518/1 — **$1,295** *BR2518/1*
Paper Express, Paper Parking, 6 Part Forms. 360 cps. draft elite, 18 pin head.

DAISYWHEEL

HR-10/2 — **$395** *HR10/2*
Portable Daisywheel printer, 12 cps, 80 columns, 2K buffer, tractor and friction feed

HR-20/3 — **$695** *HR-20/3*
20 cps. daisywheel, 8k buffer, Can be instantly turned into a stand alone, self- correcting, electronic typewriter by merely powering up the optional keyboard.

KEYBOARD for use with HR-20/3 — **$495** *KB150*
One line, 15 character LCD display

HR-40/3 — **$1,095** *HR-40/3*
40 cps daisywheel, 136 columns, Friction and rear forms tractor feed, Parallel and serial interface, Paper width of 16.6 inches.

HR-40F/3 — **$1,295** *HR-407/3*
40 cps daisywheel, same as above except French.

FUJITSU

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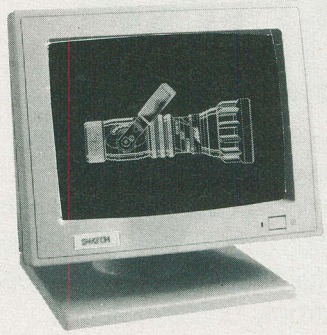

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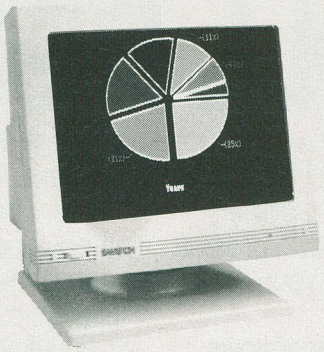

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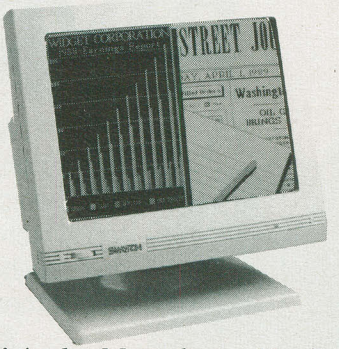

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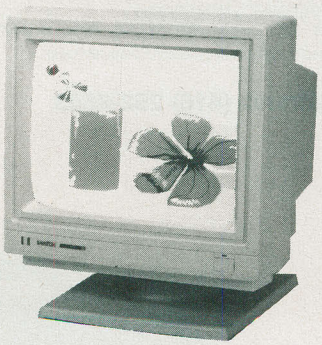

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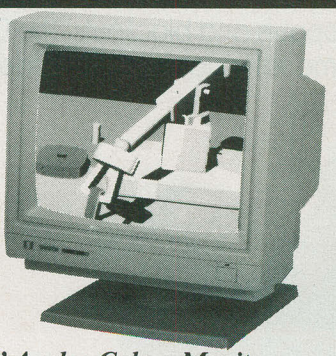

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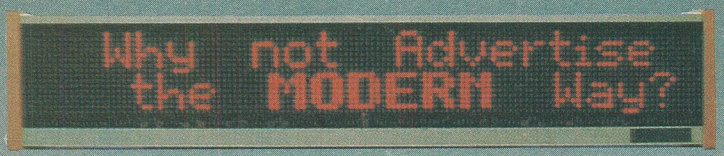

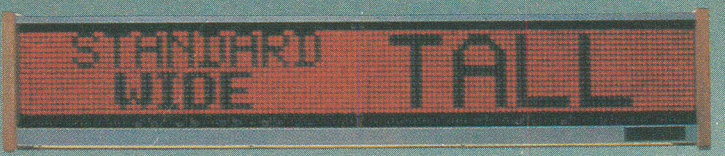

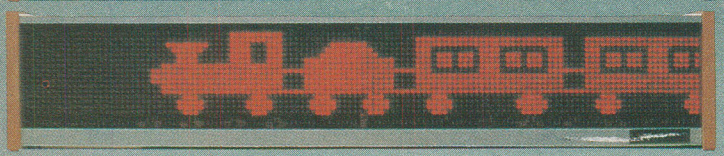

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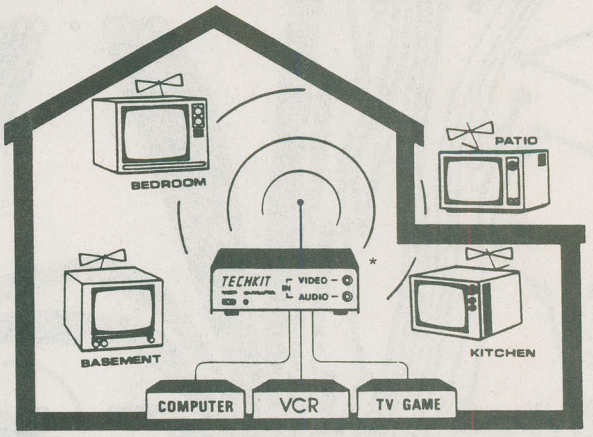

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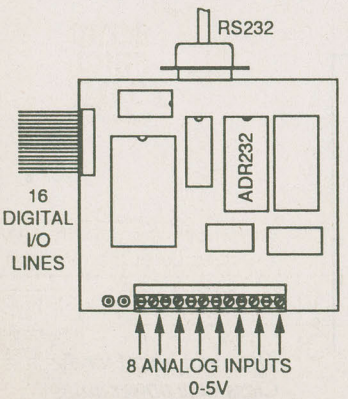

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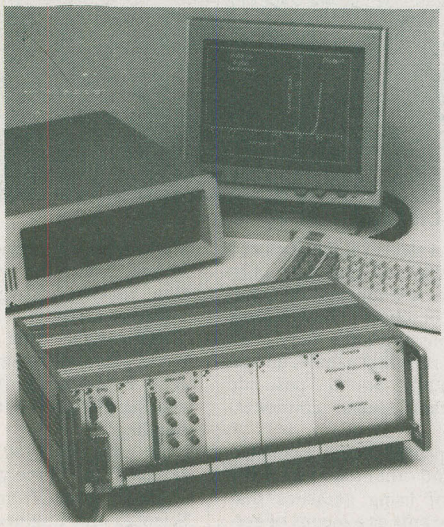

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THE SCIENTISTS TELL ME

DAVID P. DEMPSTER

An experimental robotic system that can spot and destroy moving armored vehicles up to about 550 yards away has been developed and demonstrated at Sandia National Laboratories.

Called the "Fire Ant, " it is a small robotic vehicle that carries a powerful experimental munition capable of destroying tanks and other large armored vehicles. It is operated by a remote operator viewing television pictures transmitted by a small camera on its body.

By using a radio link, the operator positions the vehicle, aims it, sets it to recognize moving vehicles, and arms the munition. With that done, Fire Ant then fires automatically anytime a large moving vehicle enters its aim point — such as an intersection of a road being used by an enemy force, for example. If need be, the operator can manually override the automatic firing system at any time.

The purpose behind Fire Ant is to permit a soldier to remain in a remote secured position while controlling a robotic weapon capable of destroying heavy armored vehicles. However, while Fire Ant is said to prove the concept, its developers say it is a demonstration system and the military has not made any firm decision about buying or using Fire Ants.

The demonstration system includes two major components — the mobile robotic vehicle / munition and the remote control unit. Basic mobility is provided by a small four-wheeled all-terrain vehicle. For demonstration purposes, the developers used a commercially available 125 cc ATV.

The gasoline-powered ATV is equipped with electrically driven actuators for remote control of steering, throttle, brakes, and weapon platform tilt. A small black & white TV camera mounted on the weapon platform sends live pictures to the controller for driving and target-detection purposes. The radio link between the controller and the ATV relays operator commands to the actuators and the camera.

The munition propels a 22-pound copper slug at more than 6,600 feet per second and can be accurately aimed at targets nearly a third of a mile away. Even the experimental munition, also developed at Sandia, is extremely compact. It appears like a large spotlight sitting atop the Fire Ant body. It is self-contained and needs no barrel, unlike most antiarmor weapons. With munition mounted, Fire Ant is about four feet tall and long and two feet wide — making it difficult for a sensing systems to detect it or an enemy soldier to spot it.

At the remote control site, video images from the Fire Ant are displayed on a small screen. Then, viewing the screen, the operator uses a joystick to accelerate, steer, and brake the vehicle. Switches control the weapons platform, and the remote starting functions. All commands are relayed to the vehicle via the radio link, but fibre-optic cables are also being studied.

Once the operator positions the Fire Ant and aims the weapon, a computer processor in the controller takes over. This processor uses the transmitted TV image to determine target motion in the camera's field of view. When the processor senses moving vehicles, it arms the munition so that it is ready to fire when the vehicle reaches the exact aim point.

Real Fire Ants

In Texas fire ants are a problem — unlike the motorized Fire Ant at Sandia, these very real ants aren't waiting for some operator to set them off — they could be doing it on their own.

The concern — what impact they could have on the tunneling and electrical nerve system of the Superconducting Super Collider (SSC). However, a leading fire ant specialist at Texas A & M University is of the opinion that there are several factors that may take a little of the sting out of such fears.

Actually, Dr. Brad Vinson, an entomologist, says no one really knows at this point whether the fire ant is going to be a serious problem. As an example, he is not concerned about the ant tunnels under the SSC causing it to collapse.

The Fire Ant battlefield robot.

Design of electrical facilities and other underground components to prohibit fire ant infestation, construction practices to protect workers from the ant's fiery sting for which it is rightly named, and an environmentally sound pesticide policy warrant special consideration.

One approach being examined by Vinson and other scientists is the possibility of using parasites that thrive on fire ants as a means of getting rid of them.

Smart Car Windows

At the University of Guelph researchers do more than spend all their time on agricultural education. In fact, not only farmers will be the beneficiaries of this latest bit of research: how to make "smart" windows.

In fact, physics professor Jim Stevens and his Swedish colleagues say the automobile industry is one of the biggest potential markets for their new technology — smart windows that regulate the transmission of radiant energy. The window does this by darkening like tinted glasses when the sun comes out and becoming transparent again when it is overcast.

Construction of the window will be like a sandwich, says Stevens. Each window will consist of two panels of glass coated on the inside with a transparent material that makes the glass surface conductive. An electrochromic layer will colour and bleach as charged atoms or ions move through lit. And in the middle, Stevens 's invention of a solid electrolyte will cement the two pieces of glass together and provide a source of ions.

Only a small power source and a sensing device will be required to tell the window whether it is dark or light. In its untinted state, a smart window will allow about 80 percent of the sun's radiant energy to pass through the glass. When tinted, transmission will be cut to about 20 percent. It will be possible to include other coatings so the glass will be selective to the amount of radiation passing through it, whether ultraviolet, visible or heat.

Obviously, this new window could mean major savings in energy costs by reducing air conditioning and heating loads in automobiles or buildings.

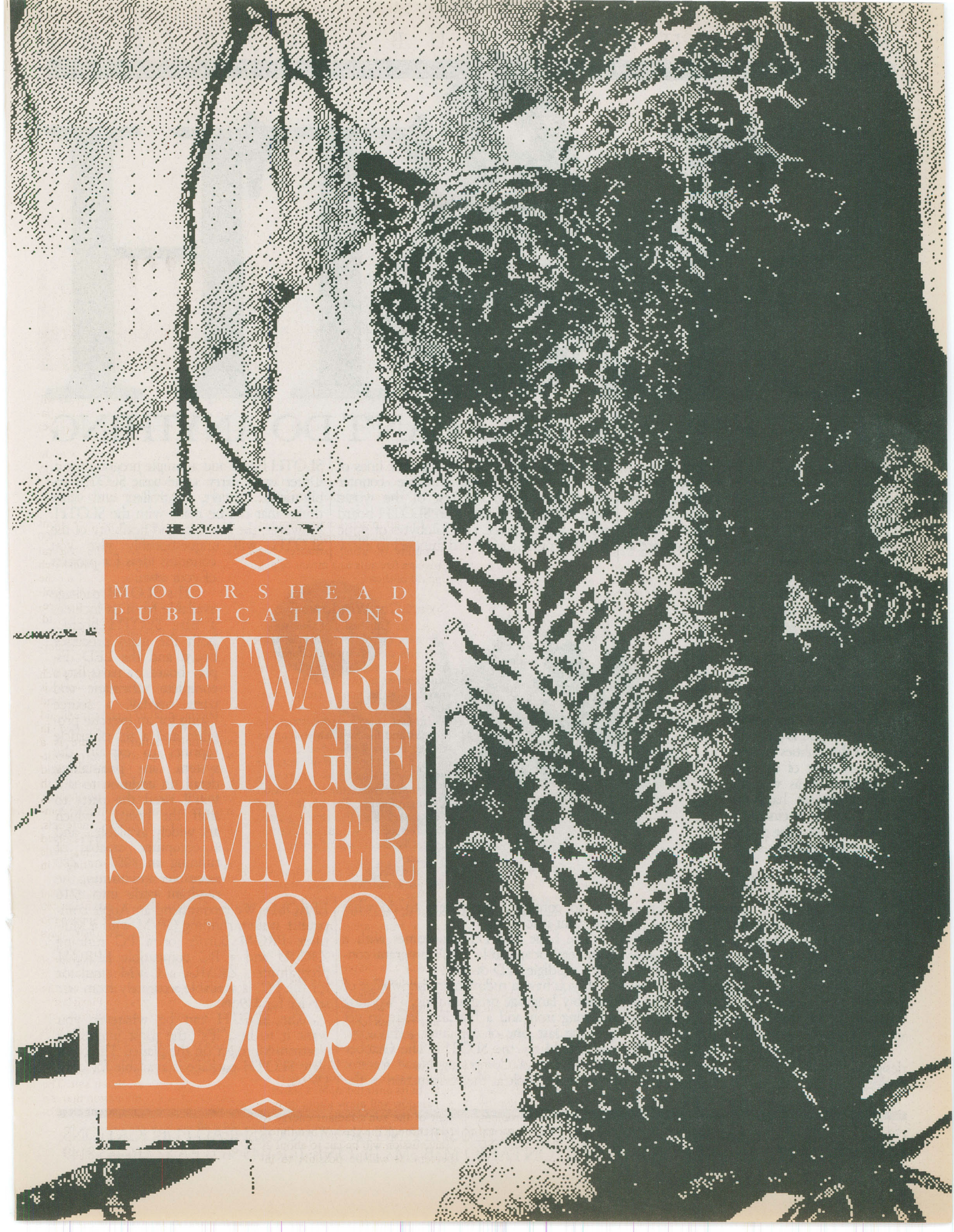
It was last fall that Stevens received a three-year, $150,000 strategic grant from the Natural Sciences and Engineering Research Council to continue studies on the chemistry of the electrolyte. Collaborating with Stevens are researchers at Hart Chemicals Ltd. and Nacan Products Ltd. who are studying the feasibility of commercial production.

The polymeric electrolyte, which makes the smart window work, is the result of Stevens's efforts to find a solid material to replace the liquid electrolytes of the type used in automobile batteries. There is a worldwide effort to develop a workable replacement for the lead acid battery (1st developed in the 19th century.) that would be lighter, more powerful and entirely composed of organic materials. However, a problem to be resolved is the fact that organic materials take up water, resulting in deterioration of the battery.

That an acrylic resin material like Plexiglas would permit ions to move through it doesn't appear too feasible to many scientists, says Stevens.

However, a chemical diagram of his electrolyte would look like a loose network or mesh of the molecules that make up Plexiglas.

Draped on this network are long-carbon-chain molecules (with properties similar to a surfactant or detergent) that have oxygen in their backbone. Some of the oxygens are complexed with a lithium salt. The end result — a combination that is a solid, adhesive, transparent electrolyte. ■



MOORSHEAD PUBLICATIONS

SOFTWARE CATALOGUE SUMMER 1989

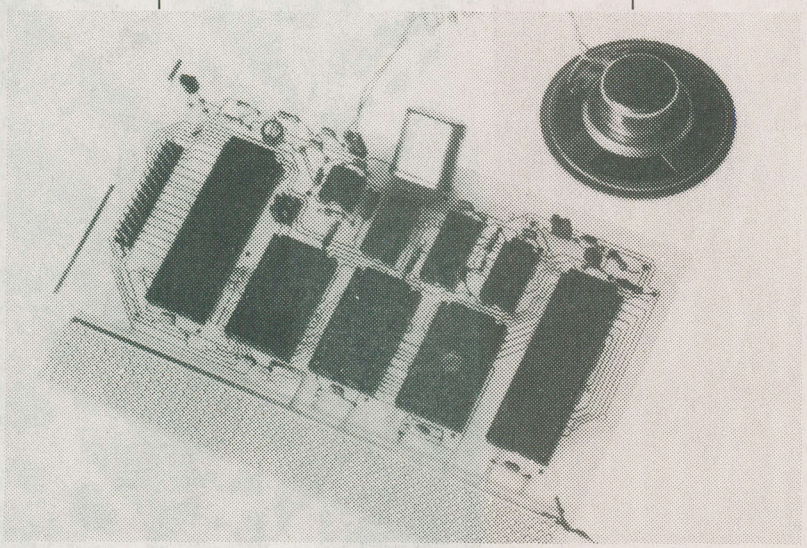
MOORSHEAD PUBLICATIONS

SLOTH

THE COMPUTER THAT CAN'T DO ANYTHING

Computers can do a lot more than just manage data bases and play video games. Specialized microprocessor boards can be used as programmable frequency counters, intelligent temperature controllers, timers, monitors... dedicated microcomputers are at the heart of most of the sophisticated high tech toys that make our lives exciting and our bank balances so easily managed with just a few fingers.

Unfortunately, most individual humans donn't get to work with small, board level micros. These things usually have to be custom designed, which is generally beyond the abilities and the means of most of us. This is unfortunate, as working with compurter hardware at this level is fascinating... and can give one the power to create unspeakably sophisticated projects.



This is why we created the SLOTH. The SLOTH is a small Z80 based computer which is designed to be turned into things. It has no screen, keyboard, floppy disks or printer port... but it's easy to get parts for, quick to assemble and painless to program. It has powerful I/O facilities to allow you to interface it to anything you want to make it work with, from the remote control of a video recorder to the ignition of your car.

The SLOTH isn't a trainer... it's designed to be built up into working projects. It's programmed with inexpensive 2716 EPROMs. It has twenty-four lines of I/O and three programmable counter timers to talk to the rest of the world with. Included on the main SLOTH board are a speaker driver, two kilobytes of static RAM, a pulse source and jumpers to allow you to configure the system to do what you want it to do.

The basic SLOTH also comes with a peripheral board to let one's program control a six digit LED display.

If you have a rudimentary knowledge of assembly language programming, a working soldering iron and a burning desire to get into the fast lane of computer technology, you should try the SLOTH. The October 1986 edition of Computing Now! features an extensive look at the construction of the SLOTH board and a sample program for it. Other issues carry some basic SLOTH applications... timers, controllers and other things that can be made with the SLOTH. However, the low cost and flexibility of the SLOTH will unquestionably give you countless ideas for projects of your own.

The SLOTH package available from us includes a bare SLOTH board... both the main processor board and the LED display board... a parts list, a complete schematic and parts overlay, a source listing for an exercise program and a set of article reprints to explain the system in painstaking detail. In addition to this you'll need the parts to stuff the board... which are widely available... and a computer capable of running an 8080 or Z80 assembler and burning the resultant code into 2716 EPROMs. We recommend an Apple compatible system running CP/M with a Multiflex PROM burner or a PC running Z80MU and a PC compatible EPROM programmer. Z80MU, a CP/M emulator for the PC, is available separately from our service for $19.95.

The SLOTH can be whatever you want it to be... it's the most interesting electronics project on the planet. The complete SLOTH package is available for only $37.95.

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ELECTRONICS & TECHNOLOGY SOFTWARE SERIES

VOLUME ONE

This is the first in a series of software collections assembled specifically for people working with electronics and related fields. In it, we have tried to include programs for a variety of interests. The Perfect speaker enclosure design program will appeal to audio enthusiasts... it gives you access to the same sort of calculation facilities that profession speaker engineers use. There are several programs which will be of help to amateur radio operators. Finally, things like BDS will find use in just about any electronic application.

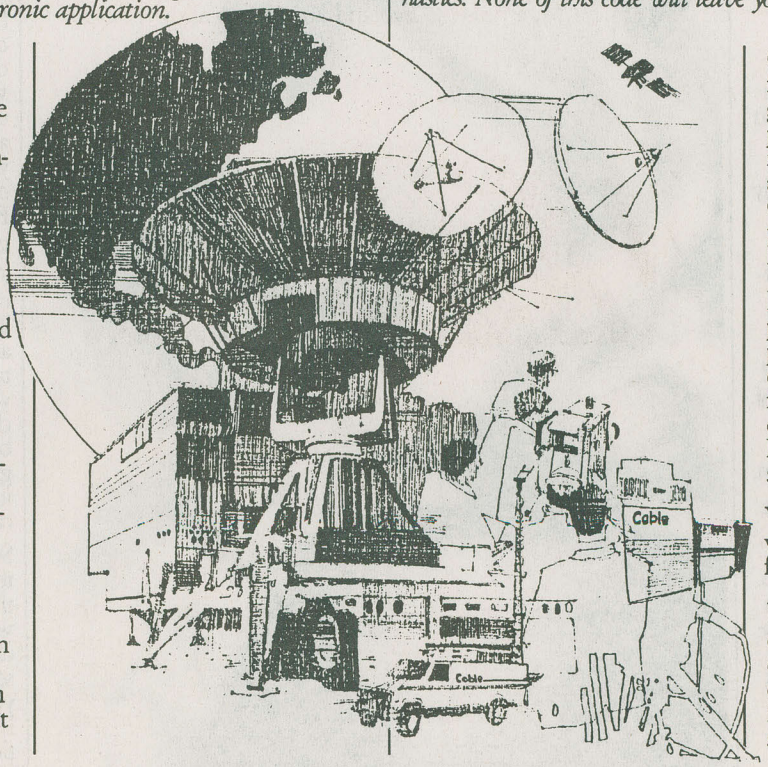
As with all our Almost Free Software collections, this one carries our promise of satisfaction. If, after checking it out, you aren't completely happy with it, we'll buy it back from you with no questions or hassles.

In addition, unlike as with other sources of public domain code, we've scrutinized all of these programs carefully for viruses and other nasties. None of this code will leave your hard drive a smoking ruin.

PERFECT is a powerful system to design speaker enclosures. It allows for a wide variety of general box designs and speaker sizes and impedances. All you do is to plug in the appropriate numbers and it will spit out both the dimensions of the box and tell you how it will perform. Saves hours of work and calculations and a lot of wasted wood.

BDS is a pop up utility especially designed for electronics. It performs a number of common calculations, including inductance, capacitance, wavelength and so on. It's better than having a paid lacky with a calculator because you don't have to feed pop up utilities.

DIPOLE is a simple program to handle the calculations for dipole antennas. It's written in BASIC so you can even take it apart and see what it's up to.



GEOS is a great program for finding the location of geo- stationary satellites. It provides everything you need to align a satellite antenna from anywhere in Canada... all without recourse to charts, books, prayer or higher mathematics.

PARABOLA is a BASIC program to help design parabolic antennas. It lets you calculate all the grotty details for anything from a Ku band dinner plate to your own DEW line backscatter radar system.

VSWRCALC calculates voltage standing wave ratios for any wavelength.

YAGI-UDA is a really complex program for an even more complex problem... designing Yagi antennas. Plug in some numbers and it will spit out a sky hook.

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VOLUME FORTY-EIGHT

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This disk carries the same promise that all our Almost Free Software does. If you don't feel that it's fair value once you've checked it out, we'll buy it back from you with no gripes or questions. If you have problems with it, our help desk is as near as your phone... just call (416) 445-5600.

If you're not already receiving it, please call us and ask to be put on the mailing list of Personal Software News, our newsletter. It's free.

DRIVEL is a brilliant addition to any office. It produces very meaningful sounding text which is actually pure... drivel. It will happily generate as much text as you want, suitable for use in memoranda, reports, letters and year end stockholders portfolios.

CPRINT is the ultimate C source file printer. Generates first class hard copy listings complete with headers, footers, page numbers and so on. It will also generate an index and table of contents for any source file.

EGARULE pops a ruler up over any EGA text screen. You can position the ruler where you need it, and use it for the accurate positioning of text in different applications. It's amazingly handy. Requires and EGA or VGA screen.

INVENTORY is a home or office inventory program which maintains a running database of your possessions. It keeps track of what everything's worth, and provides you with an estimate of the replacement costs. Reduces potential "negotiations" if you have to make an insurance claim.

JDOS will pop a command line up from within most applications. However, it does a number of clever things to allow you to have all the DOS memory in your system available for applications run from within other applications... quite the clever trick when you think about it.

MORTGAGE is a powerful mortgage program. It does a number of types of calculations, and will print hard copy reports. It's great for doing "what if" plans to find ways to slaughter your mortgage quicker.

PIZZA will teach you to make pizza at home with a variety of recipes and tips. Avoid getting anchovies in your disk drives.

POSTGIF is the best way of generating black and white printouts from full colour GIF files. This program creates true halftones... not dithers... from GIF files and stores them as EPS (encapsulated PostScript) files. These can include previews for use with Ventura publisher, too... use GIF files as black and white art for desktop publishing. If you've tried our Colour ClipArt disks, you'll want this program. Requires a PostScript printer.

SLEUTH is a fascinating graphic ASCII game. A murder has been committed in an old house. There are various odd characters around, and various clues. Your task is to wander around the various rooms, check out the clues and unmask the villain before you get crunched. The game changes with every playing, and you can use your own cast of characters if you like.

SORTDEM is a particularly interesting program. It illustrates the process for sorting a list of words using five of the most popular sorting algorithms. You can see how each one works, and you'll understand why each one is preferable for some applications. C language source code is included.

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MOORSHEAD PUBLICATIONS

ALMOST FREE™ SOFTWARE

VOLUME FORTY-NINE

This month, we wanted to say 'thanks' to everyone who'se bought our Almost Free Software collections thus far, so we created a special collection of programs. This month, we've put together a two disk set... over a megabyte of software when it's all unpacked... but the price is the same as it always was for a single volume. It's our way of telling you how much we appreciate your support of our software.

It's summer, and no one really wants to work all that hard. As such, this month's collection does lean a little heavily toward recreation. There are a few serious applications, such as the incredible mailing list and label program, the dBase file browser, the tickler and the phone number directory for Windows, but there are also a lot of really stupendous games. You won't believe your senses when you try Aldo, Fans, Chess and Tri-Maze, to name but a few. There's a whole lot more in this month's collection.

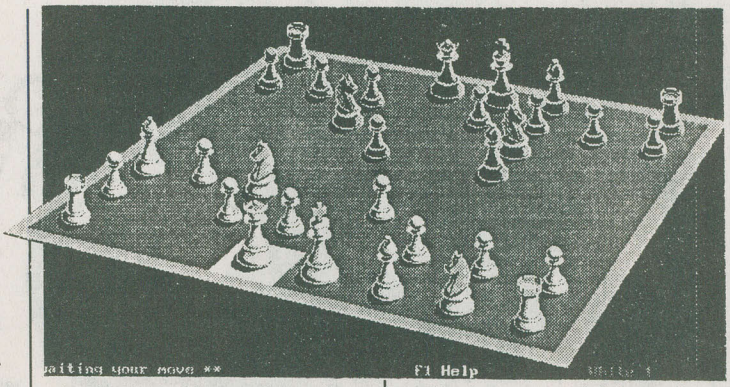
Every program on this disk has been extensively checked to make sure that it functions as it should and that it contains no viruses or other nasties. Most sources of public domain software do not provide you with this assurance. This disk carries the same promise that all our Almost Free Software does. If you don't feel that it's fair value once you've checked it out, we'll buy it back from you with no gripes or questions. If you have problems with it, our help desk is as near as your phone... just call (416) 445-5600. If you're not already receiving it, please call us and ask to be put on the mailing list of Personal Software News, our newsletter. It's free.

PHONES is a Windows application which keeps track of telephone numbers... it'll even dial 'em for you if you have a modem attached to your system. Requires Microsoft Windows. This one is a gem.

BRAIN asks you a lot of peculiar questions and evaluates how much of your thought processes are left brain, how much are right brain and how much are mixed brain. Not immediately useful, but interesting. Requires a brain.

LM is the absolutely best mailing list program and label maker ever written. If you run a small business or just send out a club news letter every so often, this program will change your perception of the universe. dBase compatible.

ONEKEY is a small, elegant keyboard macro program. It stores up to fifty strings, each one callable with the key combination of your choice. Ends buckets of repetitious typing. This is especially handy for Ventura users who precode their text. ALDO is a game in the tradition of Mario Brothers. A little fellow with a beard... could be a pizza delivery man, could be a leprechaun... leaps over barrels, climbs ladders and goes for the gold. Fast and well done, it requires an EGA or VGA card.



POPDBF is a pop up utility which allows you to browse through dBase, Clipper, Foxbase and compatible database files from within any application.

TIKLER is one of the nicest tickler programs we've encountered. It reminds you of up to three hundred events on the future, all without knotted handkerchiefs, bits of string or things written on your arm.

CAITY is small and so brilliantly pointless that we had to include it. It's a resident program. Run it and it plays a different musical note for every key on your keyboard as you run other applications. It's a delight to listen to as you type DOS commands... a veritable symphony in WordStar. Your fellow employees will want to kill you inside of fifteen minutes.

CONNECT4 is the best and most ruthless computer implementation of this popular game.

PALETTE allows you to set the colour palette in Windows sensibly. If you don't know you need this program you don't know how badly you do. C language source code is included. Requires Microsoft Windows.

LIFE is a three dimensional version of the now classic program. Watch a colony of creatures lunch out on each other. Primary a programmer's toy, the C language source code is included.

TRI-MAZE is a blast. It draws mazes and then challenges you to solve them. The mazes can be mercilessly complex, and the game gives you ample tools to help you navigate them.

PERIODIC is a brilliant bit of work. It displays the periodic table and lets you scan a cursor over it to get detailed information about each element. Ever wake up wondering about the atomic weight of Iridium? Happens to all of us sooner or later. Requires an EGA or VGA card.

FANS is actually supposed to be an EGA demo for a graphics library, but it's so fast and so good that we've included it here. It's actually a game in which you pilot a space ship through a field of waving fans catching bouncing loonie dollars as you go. No foolin'... An EGA or VGA card is required.

CHESS will hurt your brain. This is a three dimensional chess game which plays a wicked game and actually allows you to move the pieces around, rather than just typing in co-ordinates. This has to be the last word in computer chess. Requires an EGA or VGA card.

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Almost Free Ventura ClipArt picture collections are disks full of image files. Each disk has a variety of pictures, both for spot illustrations and full pages. They're suitable for reproduction on any output device. Almost free clip art now supports Ventura Publisher, Aldus PageMaker and WordPerfect 5. In fact, it is compatible with almost all desktop publishing packages, paint programs and word processors which accept graphic files. Each disk comes with a utility to convert the clipart to MacPaint, GEM/IMG, PC Paintbrush PCX and PCC, and TIFF file formats, suitable for use with a wide variety of applications. Only $19.95 each.

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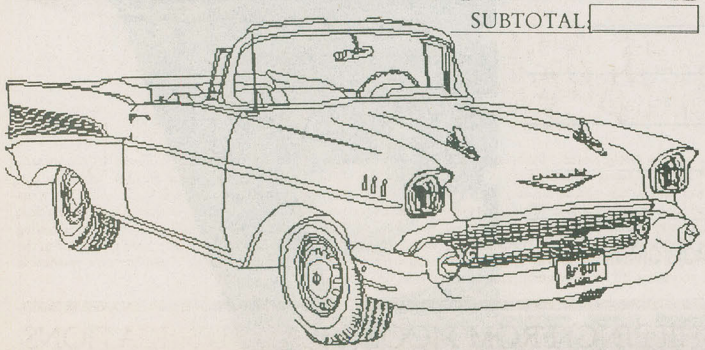

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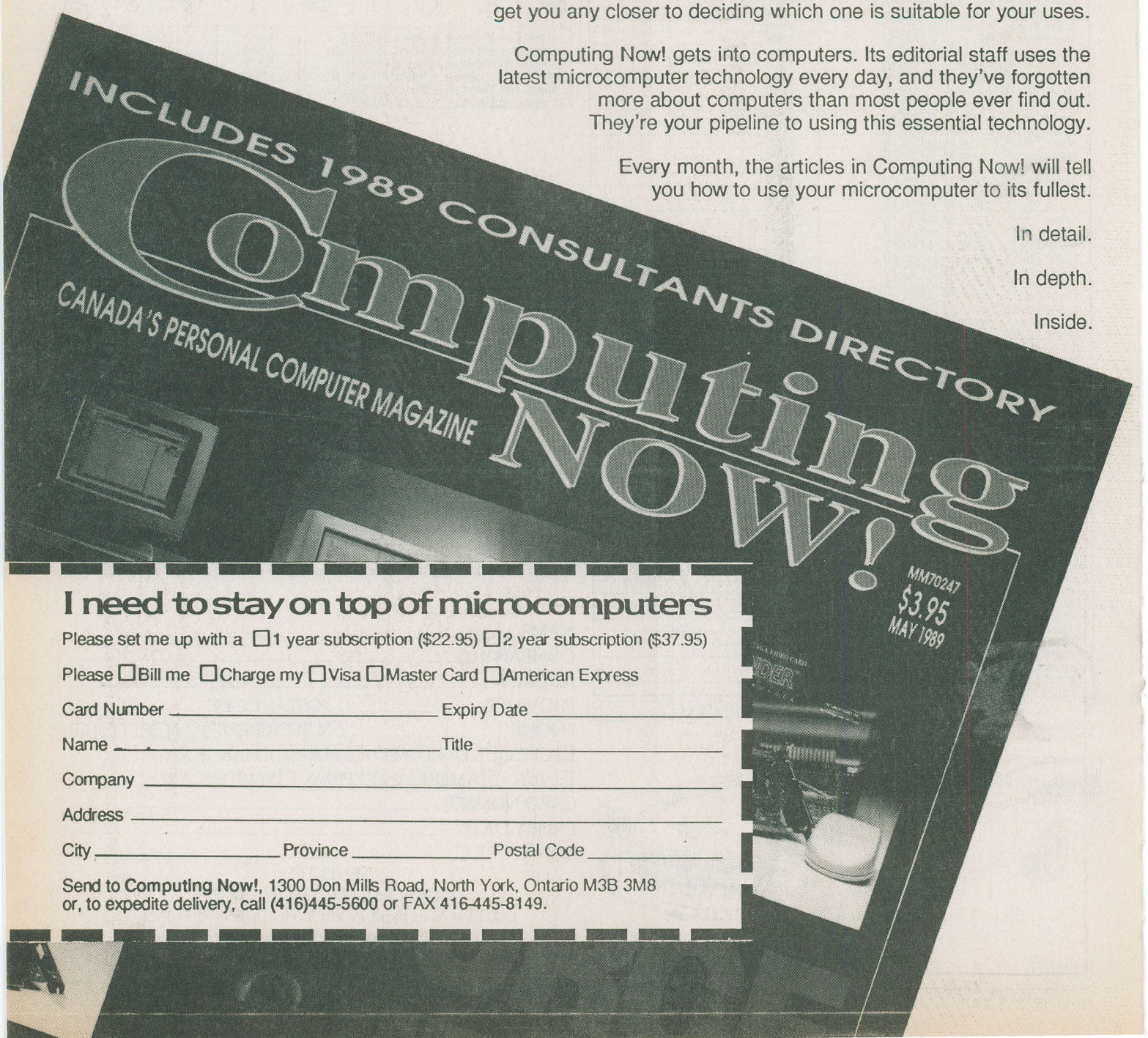

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 Continued from page 6

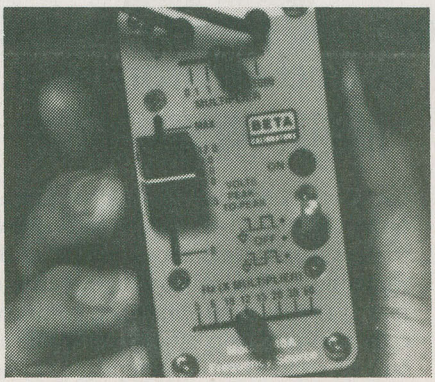
Battery Support System

The Christie CASP/2000 Universal Battery Support System is a microprocessor-based charger/rejuvenator that can handle any type of rechargeable battery, or a combination. It provides analysis of the battery, optimum charging rate, amount of charge retained, etc. The waveform improves the cell's internal structure. Christie Electric Corp., 18120 S. Broadway, Gardena, CA 90248, (213) 715-1402, fax 618-8368.

Circle No. 4 on Reader Service Card

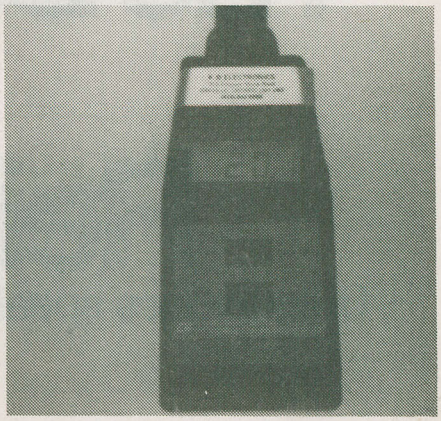
Frequency Source

The Beta Model 440 is a pocket-sized calibrator with 40 precise frequencies from 5Hz to 60kHz. The output is a square wave of 15V peak-to-peak amplitude and a frequency accuracy of +/- 8 parts per million. 200 hours of operation is provided by two 9V batteries. Beta Products, 2029 McKenzie Drive, #150, PO Box 115004, Carrollton, TX 75011-5004, (214) 241-2200.



Circle No. 5 on Reader Service Card

Humidity/Temp Meter



The HT-3001C provides readouts of relative humidity from 10% to 95% and temperature from 0-60°C. Accuracy is +/- 3% RH and +/- 0.5% on temperature. It also features a data hold function and a carrying case. KB Electronics, 355 Iroquois Shore Road, Oakville, Ontario L6H 1M3, (416) 842-6888.

Circle No. 6 on Reader Service Card

Continued on page 45

The Bose Answer to Sound Reinforcement

Unique bass speakers and proper measurement optimize the sound environment.

TIMOTHY PALMER-BENSON

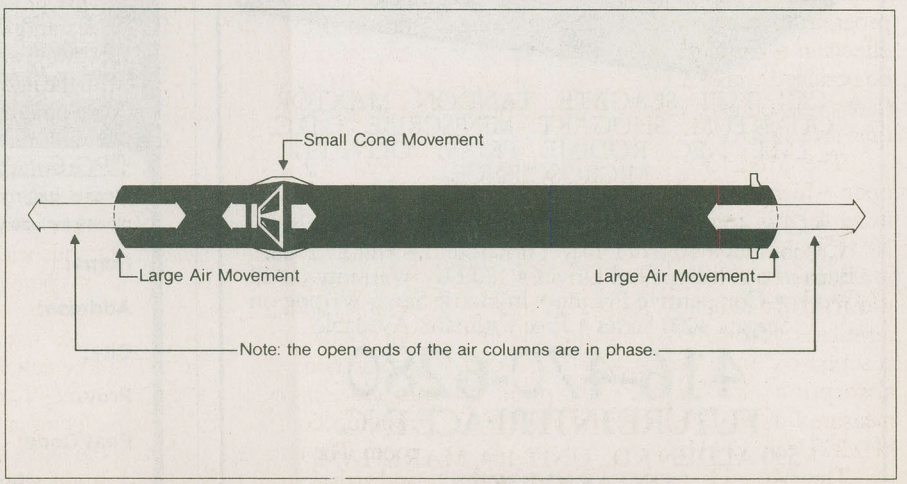
The experience of hearing recorded music outdoors or in a public area such as an arena can be just as pleasurable as hearing it indoors. In "free air" there's little reverberation. If there is any, it often imparts a pleasant effect. However, creating a truly pleasing sound in such locales, while at the same time providing adequate coverage of a large area, requires expertise. There is more to it than just installing the largest horn loudspeaker one can find somewhere and coupling it to the most powerful amplifier available. No - to derive the maximum benefit in such situations requires both the right equipment and the expertise. Horn-type loudspeakers are efficient users of energy and concentrate the sound in a beam, but they are frequently large and cumbersome. For some, the use of multiple cone drivers in a small enclosure designed to produce a broad frequency range is an alternative. Such systems, when used with suitable "signal shaping equipment," and high power amplifiers can produce "hi-fi sound" over a wide area.

This was my conclusion after a recent visit to Whistler Mountain in BC. The ski resort has installed - more or less permanently - a respectable, yet simple Bose loudspeaker system on one of the many race hills. For the first time I heard clarity - even some distance away. There was a richness in the race announcer's voice. Music was full range and made pleasant listening. With the good sound came a story of how an enterprising and respected U. S. speaker company has captured the Canadian market for what is called "sound reinforcement."

The backbone of sound reinforcement in public areas as far as Bose is concerned is the company's 802 Articulated Array system. Based on research dating back to the 1960s, the 802 loudspeaker has proved ideal for both indoor and outdoor professional use. It doesn't mind whiteouts, -20 Celsius temperatures or rain. It's eight drivers, mounted symmetrically in vertical pairs on a special baffle assembly, seem to go on pumping away not matter what the weather is doing. The drivers have low impedance, "edge-wound" aluminum voice coils. "Tuned Reactive Air Columns" - that look like little tubes protruding from the front of the speaker - reduce distortion by controlling the cone excursion required to reproduce deep bass frequencies. A built-in Directivity Control circuit maintains vertical dispersion at high frequencies while protecting the drivers from the high frequency overload. Frequency response is 50 Hz to 16 kHz, acoustic output is in excess of 92 dB SPL for a one watt input at one metre and maximum power handling is 240 watts continuous (rated with pink noise).

A necessary part of any 802 installation is a signal processing device called the 802-C system controller. The device serves the functions of three equalizers and ensures that the speakers produce sound throughout their rated frequency spectrum. The device contains an automatic switching circuit as well as an electronic crossover. Sharp limiting of subsonic and ultrasonic band-limiting filters are said to reduce power wastage, and high frequency instability. A 200 watt per channel power amplifier is usually used with the system.

They've had Bose systems at Whistler since 1984 when the Mens' World Downhill Cup was held there. Sixty 802s were strategically placed up and down the two and a quarter mile course. A balanced 1-volt line served each amplifier and speaker installation. "It was the first time there'd been a sound system throughout the course," recalls company spokesman Dan Fraser. Whistler officials were pleased by the comments they received



The Bose sound reinforcement system, including the Acoustic Wave Cannon, which operates from 25 to 125Hz.

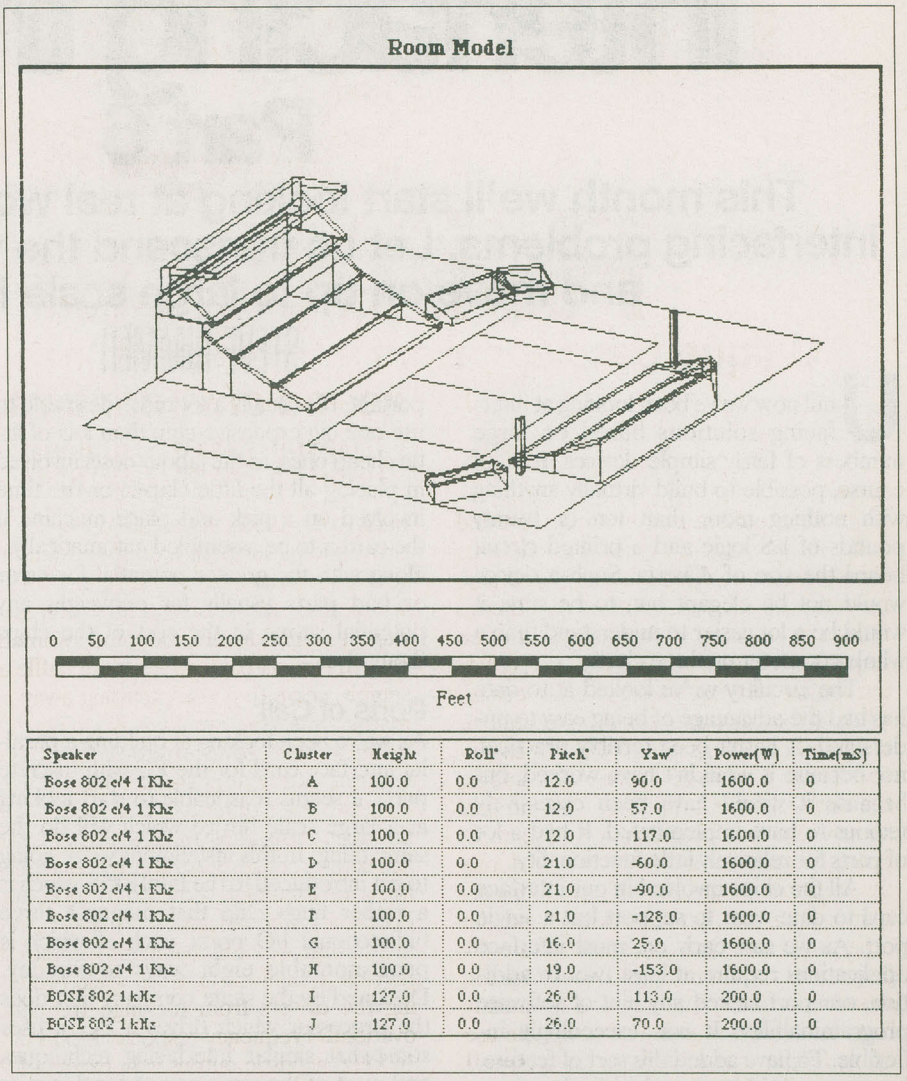
from some of the 15,000 spectators about the quality of sound reproduction and a recommendation from Whistler helped Bose go on to bigger and better things. Several plums have fallen into the Bose lap since then. The company won a major sound contract at the Calgary Winter Olympics and Bose systems were installed at 12 venues. The locales ranged from ice arenas to ski slopes. The installations were said to be the most extensive and elaborate in the history of the Winter Games. One of the biggest installations was at Olympic Plaza. Twenty-four 802-11s and 12 Acoustic Wave Cannons (used for low frequency reinforcement) were installed for the "Federal Express Festival of Lights" - an event that was seen and heard by approximately 50,000 people for 16 successive nights. Now Bose is involved in another major venture; the installation of a sound system for the opening ceremonies of Toronto's new stadium.

For the last few years, the placement of Bose loudspeakers in arenas, dance halls, auditoriums and ski hills has been determined by a computer program developed by Bose researchers and by Tom Birkle, a programmer with David L. Adams Audio Consultants in Denver. The program is called "The Modeler" and is available to Bose dealers who perform these types of installations. (There are approximately 15 dealers throughout the country who are trained to use the program). The Modeler allows an installer to draw an area to scale in three dimensions on an Apple or MacIntosh computer. The graphic representation can be rotated for viewing at any angle and there's a special plane priority scheme that handles the acoustic simulation of obstructions such as balconies. This enables the program to calculate acoustic shadowing effects in a particular area. Readings can be obtained within a few seconds on such things as sound pressure levels (SPLs), time arrivals and reverberation.

The Modeler uses a vast database upon which to base its calculations. For example, it is possible to select more than 30 types of building materials. A new material can be added at anytime provided that its sound absorption characteristics are known. (Any building material is supposed to be provided with a sound absorption coefficient. Absorption is measured at 125 Hz,, 250 Hz, 500 Hz 1 kHz 2 kHz and 4 kHz.)

The Modeler program comes with charts on performance characteristics of more than 40 loudspeakers. The information is quite detailed. SPL figures are provided for different frequencies and for different distances (up to 90 feet away) and up to 180-degrees off axis. As with the information on building materials, data on other loudspeakers can be added at any time. When all the information has been entered the program displays an SPL map of a listening area along with information about reverberation times at different frequencies. The program will allow the user to zoom in on a specific part of any previously drawn area and it will produce grey scale maps representing sound pressure information. In addition, the program has a "time-of-arrival function" for any particular point in a room. The user gets a graph of the intensity and arrival time of wave fronts produced by the sound sources. "We look for a standard deviation of + or - 3 dB," explains Dan Fraser at Bose. "One kilohertz, 2 kHz, 3 kHz and 4 kHz are the crucial frequencies for coverage. If the set up works well at these frequencies then we can more easily fix problems in other areas of the audio spectrum assuming of course that full range speakers are being used."

No one in Canada knows more about the Modeler program than Fraser. He is responsible for training dealers and for assisting them with installations. He says it takes about three months for someone to become completely familiar with the program. Fraser has helped design Bose installations throughout the country from Expo '86 in Vancouver to the St. Johns' Regatta in New Brunswick. The next time you are at any outdoor event and you see a Bose speaker array, he will probably have had something to do with it. ■



Speaker	Cluster	Height	Roll°	Pitch°	Yaw°	Power(W)	Time(mS)
Bose 802 e/4 1 Khz	A	100.0	0.0	12.0	90.0	1600.0	0
Bose 802 e/4 1 Khz	B	100.0	0.0	12.0	57.0	1600.0	0
Bose 802 e/4 1 Khz	C	100.0	0.0	12.0	117.0	1600.0	0
Bose 802 e/4 1 Khz	D	100.0	0.0	21.0	-60.0	1600.0	0
Bose 802 e/4 1 Khz	E	100.0	0.0	21.0	-90.0	1600.0	0
Bose 802 e/4 1 Khz	F	100.0	0.0	21.0	-128.0	1600.0	0
Bose 802 e/4 1 Khz	G	100.0	0.0	16.0	25.0	1600.0	0
Bose 802 e/4 1 Khz	H	100.0	0.0	19.0	-153.0	1600.0	0
BOSE 802 1 kHz	I	127.0	0.0	26.0	113.0	200.0	0
BOSE 802 1 kHz	J	127.0	0.0	26.0	70.0	200.0	0

At the top is a computer model of an installation showing the speaker locations. At the bottom is the computer printout giving all the required details of actually positioning the speakers.

FEATURE

Interfacing the PC
Part 6

This month we'll start looking at real world solutions to PC interfacing problems. Let us transcend the world of discrete chips and move on up to large scale integration.

STEVE RIMMER

Until now we've been looking at interfacing solutions based on large numbers of fairly simple devices. It is, of course, possible to build virtually anything with nothing more than ten or twenty pounds of LS logic and a printed circuit board the size of Alberta. Such a device would not be elegant but, to be sure, it would be a lot easier to understand than a whole computer on three chips.

The circuitry we've looked at to date has had the advantage of being easy to understand. It hasn't been terribly practical, not because it wouldn't have worked, but because it would have been excessively tedious to have implemented. It had a lot of parts for relatively little functionality.

All the chips involved in our interface card to date went to support but a single port. As we saw early on, most interface applications require at least two. In addition, our port lacked any hint of software programmability. It was exceedingly inflexible. To have added this sort of feature, however, would have sucked back quite a few more chips.

Unless you're right out there with your toes curled over the leading edge and your face staring into the void, you'll probably find that your interface project has, to some extent, been done before. In fact, most applications for PC peripheral cards have been done so many times before that there are now complex chips available to handle the works. These sorts of chips typically do everything that a herd of small scale devices will handle, but they do it faster, with less power consumption, more reliably and cheaper.

The only drawback, of course, is that one can have no idea as to *how* they do it. They are, quite literally, black boxes. However, in the real world no one really cares how it works so long as you can't get sued for it.

In designing practical PC interface cards, getting the "package count"... the number of chips... down is really quite important. It's usually a lot more desirable to use one big expensive chip than lots of little cheap ones, as the labour costs involved in placing all the little chips... or the time involved on a pick and place machine if the card is to be assembled automatically... along with the greater potential for error or bad parts usually far outweighs any potential saving in the cost of the chips themselves.

Ports of Call

As we've been looking at building a parallel interface card for the PC with discrete parts, it seems reasonable to start looking at a large scale device which will do the same thing. In this installment we're going to get introduced to the Intel 8255, which is a rather huge chip that manages three bidirectional I/O ports, each of which is programmable eight ways to Sunday. Designed by the same company that does the processor which drives a PC, it uses somewhat similar interfacing techniques and most of the same names for things as does the 8088.

Interfacing an 8255 to a PC is quite a lot simpler than having the PC talk to our handful of chips last month. However, for the moment, let's concentrate on the beast itself.

The 8255 is a general parallel port chip designed to be used with a port driven microprocessor. As we've seen in the past few months, when the processor wants to talk to a port, it puts the port address on the lower part of the address bus and the data on the data bus, and it then pulls the IOW line. In the case of the 8255, the port chip maps onto several consecutive ports, as we will require a range of ports to be able to properly control it.

There are twenty four input/output lines squirting out of the 8255. These can be regarded as being three eight bit ports and, for reasons which will be obvious shortly, this is really how the chip deals with them. However, they can also be programmed into other combinations. For example, we can treat them as two twelve bit ports. We'll get into this momentarily.

We're going to pretend that we've already gotten past all the technical details of interfacing the 8255 to our PC for just a moment so we can look at the characteristics of the chip itself. While this may seem like an awkward order in which to handle the task, it's usually how things are done with large scale devices like this one. It's important to understand how the 8255 behaves from the point of view of the software which will drive it so that we can understand how best to handle its hardware.

In this case, we're going to have our hypothetical 8255 decoded so that its range of ports starts at 0300H... when we get to the actual interfacing circuitry you'll notice that some of our previous card will have made the transition into this new incarnation.

Interfaced like this, the 8255 will appear as four consecutive ports to the processor. In machine language terms, we would define these as

```
PORT_AEQU300H
PORT_BEQU301H
PORT_CEQU302H
CONTROLEQU303H
```

This is very much less mysterious than it seems at first.

In its simplest mode, every input/output line of the 8255 can be set up in one of two states, to with, as input or output. Now, the chip doesn't actually allow us to individually set the state of every line, but, rather, implements a number of reasonable permutations. The actual configuration of the twenty four lines is determined by the setting of a mode byte. This byte, not surprisingly, is sent to the chip through the control port, that is port 303H in this case.

In order to use the 8255, we must set

the mode byte to tell the chip which of its ports are going to be input ports and which will be output ports. We can then deal with the ports directly by reading from and writing to the three data ports from 300H to 302H. For example, if the first port of the chip were to be defined as an output port, we would subsequently write to it by saying

```
MOVDX,300
MOVAL,45
OUTDX,AL
```

The number 45 is the data being written to the port.

Initialization

Initializing the 8255 is fairly complex. However, it's the only complex thing about the chip. Once you've initialized it, communicating with it couldn't be simpler.

The 8255 can be set up to work in three modes. These are

Mode 0Basic single directional ports
Mode 1Interrupt driven mode
Mode 2Bi-directional mode

We're going to look at mode zero right at the moment. The other two modes are powerful, and will prove useful later on when we're developing interrupt driven strategies for the card. However, for the moment, let's just make the beast talk.

The mode we choose is communicated to the 8255 through a mode byte, which, just for the sake of perversity the chip's documentation likes to think of as a "mode word". As with most of the well bred bytes, this one is made up of eight bits, and every bit has a meaning all of its own. Here they are

Bit 0Port C lower : 1 = input, 0 = output
Bit 1Port B : 1 = input, 0 = output
Bit 2Mode select : 0 = mode 0, 1 = mode 1
Bit 3Port C upper : 1 = input, 0 = output
Bit 4Port A : 1 = input, 0 = output
Bit 5Mode select
Bit 6Mode select : 00 = mode 0, 01 = mode 1, 10 = mode 2
Bit 7Mode set flag : 1 = set mode

This actually defines the functions of the chip very elegantly if you stare at it for a while. The 8255 behaves like two separate devices, or, at least, it can if you ask it to. Obviously, if you program both devices with the same mode information it behaves like one device. The first device consists of port A and the upper four bits of port C. The second device, logically enough, consists of port B and the rest of port C.

This distinction allows us to program each device with a separate mode if we want to. This is useful because the interrupt mechanism of the chip uses port C to actually do the interrupting.

In our examples here we'll be programming the 8255 so that both of its sections will be running in mode zero. As such, it will behave like a single device, and we can ignore its schizophrenia.

In order to set the mode of the chip, then, we must assemble the control byte out of the appropriate bits to program the 8255 for the functions we want. Let's walk through a simple example. In this case we want port A to be an input port and ports B and C to be output ports.

First off, bit seven must be one, as this is a flag to tell the 8255 that the data being sent to its control port is to be regarded as being a mode change. Thus, we start with 80H.

Next, let's set the mode for port A and the upper part of port C. We want this to be mode zero, the simple I/O mode. This means that bits five and six must both be zero. Our mode control byte is still 80H.

Port A is to be an input port. To do this, bit four must be one. We thus OR 80H and 10H... 10H being what you get if the fourth bit of a byte is set. The result is 90H.

Port C is to be an output port. We can set the upper hap of it so by making bit three zero. We're still at 90H.

The mode for port B and the lower half of port C is zero, so bit two will be zero. Port B is an output port, so bit one will be zero. The lower half of port C is an output port too, so bit zero will be zero.

Our mode control byte is 90H.

Having worked this out, we can set our chip up with the following bit of code

```
MOVDX,CONTROL
MOVAL,90H
OUTDX,AL
```

If we now do this

```
MOVDX,PORT_B
MOVAL,55H
OUTDX,AL
```

every other line of port B will go high. The number 55H is a particularly useful one for these kinds of tests, as it has all its odd numbered bits high and all its even numbered bits low. It's unlikely to occur as a garbage byte, and so it's a useful check to see if something like this is working.

Calculating the mode bytes for 8255 initialization is a genuine pain. To this end, the following bit of assembly language is really helpful. Aside from being easier to use, it keeps you from making mistakes. This is worth the effort, as having the 8255 incorrectly initialized can make it do the weirdest things.

```
PORTC_MODEEQU00001001B
PORTB_MODEEQU00000010B
PORTA_MODEEQU00010000B
8255_MODEEQU01100100B

    MOVAL,80H
    ORAL,8255_MODE
    ORAL,PORTA_MODE
    ORAL,PORTB_MODE
    ORAL,PORTC_MODE
    MOVDX,CONTROL
    OUTDX,AL
```

I've set the significant bits of each of the four equates to one so you can see where they are. In this case, we've set all the ports to output and the chip into mode two for both devices. The mode control byte would be 0FFH. In practice, you'll probably want to change this.

Actually, in practice you'll probably let the compiler OR the four bytes together, rather than doing it in assembly language, that is

```
MODE_BYTEEEQU8255_MODE OR
PORTA_MODE OR PORTB_MODE
OR PORTC_MODE
MOVDX,CONTROL
MOVAL,MODE_BYTE
OUTDX,AL
```

The first line has wrapped here... it all has to go on one line in an assembler program.

Post Initialization

The 8255 is quite an old chip, predating the 8088 that the earliest PC's were based on. Its documentation speaks of its being used to control things like the hammer relays of a teletype. However, it's a good chip to use for this sort of application. It's cheap, fast and pretty easy to get up and running.

As we'll say later on, it's also incredibly flexible... possibly more so than one might ever require. ■

FEATURE

Techie's Guide to C Programming Part 6

Loops are a basic tenet of any language. C offers us a variety of powerful loops. Having said all this, it will be fairly obvious what we're going to look at this month.

STEVE RIMMER

Being largely incapable of original thought unless they're having some sort of random memory problems, computers are most adept at doing the same things over and over again. As computers can typically do the same sorts of things over and over again much more quickly and with fewer union problems than human being experience, it's not surprising that programming languages contain lots of interesting ways of making them do this. Looping is one of the most elemental functions of programming.

It's fairly easy to create a program loop. What's quite a lot more difficult to is manage complex loops elegantly and with a minimum of *goto* statements. Oh yes... and it's also important that we be able to get out of our loops after a while.

There are three basic loop structures in C and, while all of them are sort of similar, each one has unique characteristics which will determine when each is to be used. Like everything having to do with C, loops are weird and obtuse at first. Later on they won't be quite so weird.

C will always be obtuse.

The *for* Loop

The most obvious loop structure under C is the *for* loop. It is actually the most complex loop that C provides us with, but it will be the easiest one to understand if you've done some BASIC programming, as BASIC has a FOR NEXT loop structure which is analogous to the *for* loop under C.

The *for* loop is used to do something for a fixed number of iterations... most of the time. This is a simple example of the beast.

```
int i;

for(i=0;iP;++i) putch('*');
```

This bit of code will print a line of eighty asterisks across your screen.

The *for* loop takes three parameters. The first one is the "initialization". It tells the loop what the controlling variable will be and optionally sets it to something. In this case, the variable is *i* and it starts at zero.

The next parameter is the "limit". This tells the loop what the status of the controlling variable has to be such that the loop stops looping. In this case, *i* has to be equal to or greater than eighty.

Deep inside the workings of C, the expression *iP* will evaluate out to be false if *i* is not less than eighty and true otherwise. This is important to keep in mind.

The third parameter tells the loop what, if anything, to do to the controlling variable on each iteration. In this, case, we increment *i*.

This is very, very powerful, as we can do all sorts of other things to it. We're going to look at a uniquely weird one in just a moment.

Here's a variation on the above bit of code.

```
for(i=80;i0;--i) putch('*');
```

This does the same thing, except that it counts backwards.

Here's a more complex *for* loop, one which illustrates a bit of the flexibility of the structure.

```
for(i=0;iP;++i) {
putch('*');
++i;
}
```

This will only print out forty asterisks, as the value of *i* gets incremented twice with each iteration.

Note that, as with all C loop structures, we can have a single function call in a *for* loop without requiring that we surround it with curly brackets. Anything beyond this requires that we do, such that there is no ambiguity for the compiler as to which things are part of the loop and which are not.

Here's a rather more obtuse loop.

```
char b[65];
int i;

strcpy(b,"There once was a hermit named Dave");

for(i=0;putch(b[i]);++i);
```

You will probably be able to guess that this will print the string "There once was a hermit named Dave". It might not be quite so obvious how it does this.

You'll recall that, under C, a string of text is treated as an array of characters. The notation for getting at one element of a string is

```
b[i]
```

where *b* is the string and *i* is an integer containing the number of the character we'd like to get at. If *i* is zero, *b[i]* will return the first character in the string.

You'll also recall that, under C, a zero value is regarded as being false and everything else is regarded as being true. Strings are always terminated by zero bytes.

In our obtuse little loop, above, the value of *i* starts with zero, so when we execute *putch(b[i])*, we will print the first character in the string. The *putch* function always returns the character it has printed, so we'll get the ASCII value of "T" at the

first iteration. This is not zero, so it's a true value.

The loop will keep going so long as its second parameter is true. This being the case here, the loop will execute its third parameter... incrementing *i*... and go around again. It will keep doing this until *putch* prints and returns the zero byte at the end of the string.

Here's a very slightly more obtuse variation on the above loop.

```
for(i=0;putch(b[i++]););
```

The *for* loop allows us to leave one or more of its parameters blank. In this case, there is no need to increment *i* in the third parameter as we've managed to do it in the second. There is no advantage to doing it this way except to be snarky but, then, you'd probably never use a *for* loop like this in real life, either.

Here's a still more obtuse one. In this case, we'll assume that *p* points to a string.

```
for( ;putch(*p++); );
```

This will be obvious if you think about what it's doing. Note that the first and third parameters of the *for* loop are blank.

Under C, a *break* located within a loop will cause the program to break out of the loop. For example,

```
for(i=0;id0;++i) {
if(kbhit()) break;
sleep(1);
}
```

The *kbhit* function returns true if a character is waiting at the keyboard, and false otherwise. The *sleep* function pauses for as many seconds as are specified in its argument. This loop would normally do nothing for one thousand seconds, or a little over a quarter of an hour. However, if you hit a key while it's waiting it will break out of the loop and go on to whatever the next thing in the program is.

This next creature is a particularly obtuse *for* loop. If you find something like this in a program you can be pretty certain you have some code written by a programmer who has read far too many C manuals.

```
for(;;) {
if(kbhit()) break;
putch(7);
}
```

This will beep forever unless a keyboard character is hit. This is simply an endless loop with no provision for its termination unless a *break* is executed. In practice, this is a very sloppy way to handle such a loop. No loop is ever uninterruptable by design... programmers who do this are usually sneaking around writing a loop which allows for all the circumstances of terminating a complex loop.

Finally, this is my all time favourite perverted *for* loop. This example uses some things that are specific to Turbo C.

```
struct ffblk f;
int r;

for(r=findfirst("*.*",&f,0);!r;r=findnext(&
f)) puts(f.ff_name);
```

This will print out the current directory of whatever disk it's run on. The *findfirst* function gets the name and other particulars of the first file in the directory and puts them in the *struct* called *f*. Assuming that it finds a first file name, it returns zero. The *findnext* function gets the next file name and puts it in *f*. It, too, returns a zero if it finds a file name.

Typically, one calls *findfirst* once and then *findnext* over and over again until it runs out of file names, indicated by its returning a non-zero value.

Note that we put the return values in *r*. The structure of this *for* loop, then, is simply to execute *findfirst* once and *findnext* after each iteration of the loop until *r* becomes false. It makes sense when you work it out, but it's a nice, crafty bit of code none the less.

The *while* Loop

It's very often the case that we don't know how many times a loop is going to be iterated before the loop starts. While we've just seen ways to trick a *for* loop into managing such a situation, C offers us a much more elegant structure, the *while* loop.

Here's a simple *while* loop.

```
while(putch(*p++));
```

This assumes that *p* points to a string of text. Predictably, it will print the text to the screen.

A *while* loop has one parameter. It will keep looping until whatever is inside its parentheses becomes false. Since *putch*, as we saw, will return true values until it hits the zero byte end of a string, this loop will keep going until the whole string has been printed.

Here's a more complex *while* loop.

```
int c=0;

while(c!=13) {
c=getch();
putch(c);
}
```

This loop will make your computer into a one line typewriter of sorts. It will echo whatever you type on your keyboard to the screen until you hit enter. The ASCII character returned by the enter key is thirteen.

Note that we must initialize the *c* variable because there's a chance that it might just come up set to thirteen by accident, and the loop would never execute.

If you enter a while loop with the stuff in the parentheses evaluating out to a false value right from the start, the contents of the loop will not even be executed once.

The *while* loop is a great one for having no code in the loop, and everything that actually gets iterated inside the *while* statement itself. This rather mangled bit of code does the same thing as our previous example.

```
while(putch(getch())!=13);
```

Actually, this is a bit more elegant, as it obviates the need to have a *c* variable.

A *while* loop can be exited with *break*, just like the *for* loop was.

The *do while* loop

The third loop structure under C is unfortunate in that it sounds a bit like the second. A *do while* loop is quite distinct for a *while* loop. This is one of them at work.

```
int c;

do {
c = getch();
putch(c);
} while(c!=13);
```

This echoes whatever you type to the screen until you hit enter, just as we saw the *while* loop doing in the last example. The principal difference between this loop and the previous one is that the contents of the loop will always get executed at least once before whatever determines whether the loop keeps looping is tested. Thus, we need not initialize *c*, as it will always be assigned something by *getch* before its gets scrutinized.

It's not always obvious whether a par-

Continued on page 45

FOR YOUR INFORMATION *Continued from page 37*

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Techie's Guide to C

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ticular situation calls for a *while* or a *do while* loop... and there are plenty of programming examples wherein either will do just as well. As a rule, *do while* loops tend to be used in more complex situations. They don't lend themselves to doing something clever all on one line, but they do form the basis of a lot of well thought out, complex structures.

This is the most efficient way to print a string to the screen one byte at a time. It uses a *do while* loop. You might want to consider this and try to figure out why this is so before you read on.

In this case, *p* points to the string to be printed.

```
do {
putch(*p++);
} while(*p);
```

If you say *putch(*p)* and *p* happens to be pointing to the zero byte at the end of a string, nothing will appear on the screen because there is no character defined for the ASCII value of zero... probably to get around this sort of problem. However, *putch* will be called unnecessarily just so it can return a zero. Using the *while* loop string printing routine above, *putch* will always be called one more time than it needs to be.

This *do while* example gets around this. It uses *putch* to print the current character, increments *p* to point to the next character and uses the *while* part of the loop to test that. If the next character is a zero byte, the loop terminates without calling *putch* again and falls through to whatever's next in the program.

Endless Loops

It's said of C that the language contains a *goto* directive but that no programmer with any pride would use it. Beyond mere snootiness, this sentiment has a basis in common sense. The BASIC GOTO statement lends itself to creating spaghetti code. Under C, it's almost always possible to use loops and other control structures to avoid implementing *gotos*. The results are usually faster and more elegant, and are invariably easier to understand.

You will probably find that, as you get more deeply into C, you need less and less of what most BASIC programmers consider to be staples of the craft. C oozes with structure, and it'll flow out through your fingers if you just close your eyes and let the zen of it all overtake you. ■

AutoCAD for Electronics, Part 2

Continued from page 19

variables if you want. The operation is very convenient, much more so than using the function key toggles.

There are a number of useful dialogue boxes, which can be called from the command line or put in as a menu item:

DDRMODES – this box contains drawing aid selections, such as Snap, Grid, Ortho, Isoplane, etc. It can be used transparently by starting the command with an apostrophe. It's shown in **Fig. 7.**

DDEMODES – the Entities box lets you change Color, Linetype, Elev, etc.

DDLMODES – the Layers box gives you convenient control of setting layers, something that usually involves a lot of confusing typing.

DDATTE – this one lets you edit the Attributes of various blocks (more on this in a future issue).

Tablet Menus

The digitizing tablet offers two major advantages to the CAD user. First, you can copy paper drawings into your computer just by taping them to the tablet and going over the drawing with the cursor (digitizer cursors usually have crosshairs for precise alignment); AutoCAD allows you to adjust the scale so that the copied drawing fits the screen the way you want it. Second, you can design up to four menus and tape them wherever you want them on your tablet. Mine, part of which is shown in **Fig. 8**, has 30 columns by 8 rows. The 240 selection points let me put in just about everything I need, including the alphabet and various macros.

The menu is written exactly as described for Screens and Pulldowns, except that you preface the sections with ***TABLET1, ***TABLET2, etc.

Next Month

In a future issue, we'll be looking at drawing a complex schematic in nothing flat: tips, tricks, and attributes.

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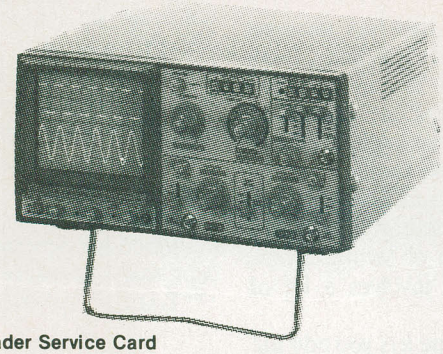

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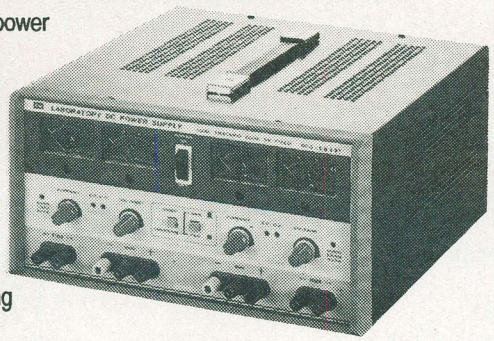

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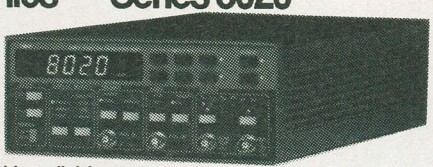

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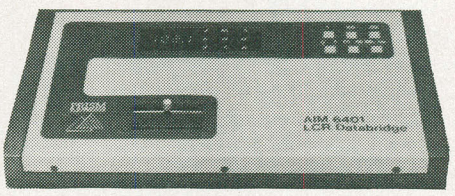

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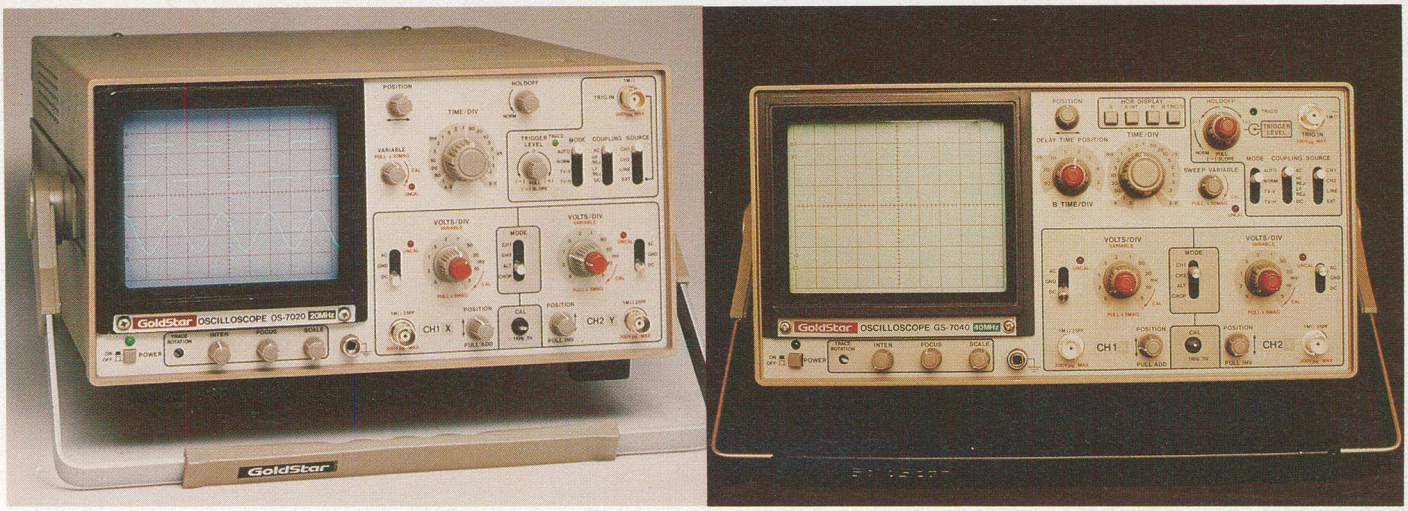

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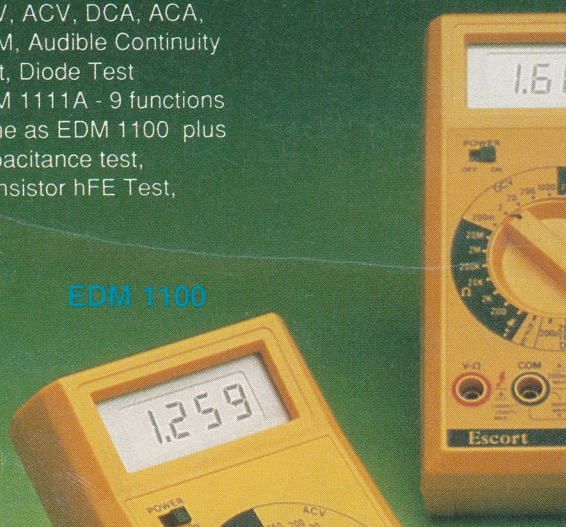

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